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April 18, 2016

Mr. William Wentworth
USEPA Region 3
1650 Arch Street
Philadelphia, PA 19103-2029

Re: *Eastern Property Boundary RCRA Corrective Action Investigation - Phase II through Phase V*
Union Carbide Corporation Institute Facility, Institute, West Virginia

Dear Mr. Wentworth:

Enclosed for review, please find one copy of the *Eastern Property Boundary RCRA Corrective Action Investigation - Phase II through Phase V* for the Union Carbide Corporation (UCC) Institute facility.

If you have any questions or would like to discuss this document further, please feel free to contact me at (304) 747-7788 or Kylie McCord/CH2M at (678) 530-4231.

Sincerely,

Jerome E. Cibrik, P.G.
Remediation Leader

Enclosures

cc: Tracy Jeffries/West Virginia Department of Environmental Protection
Jason Lankford/ Union Carbide Corporation (cover letter only)
Marianne McClure/ Union Carbide Corporation (cover letter only)
Melvin Jones/West Virginia State University
Kylie McCord/CH2M

Eastern Property Boundary RCRA Corrective Action Investigation - Phase II through Phase V, UCC Institute Facility, Institute, West Virginia

PREPARED FOR:	Union Carbide Corporation (UCC)
PREPARED BY:	CH2M HILL (CH2M)
DATE:	April 15, 2016

1.0 Introduction

This technical memorandum (TM) documents the results of Phases II through V of the Resource Conservation and Recovery Act (RCRA) Corrective Action investigation activities conducted at the West Virginia State University (WVSU) property east of the Union Carbide Corporation (UCC) Institute Facility in Institute, West Virginia (the "Institute Facility") (Figure 1). These investigation activities were completed to evaluate the potential impacts from groundwater migrating from the adjacent Institute Facility in accordance with RCRA Corrective Action requirements.

Historically, volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) have been detected in shallow and deep groundwater monitoring wells on the Institute Facility. The results of an initial investigation at the former West Virginia Rehabilitation Center (Rehabilitation Center) property conducted in March 2013 (i.e., Phase I) (Figure 1) concluded that constituents of potential concern (COPCs) detected at the Institute Facility may have migrated beneath the adjacent property. At the time of the investigation, the former Rehabilitation Center was owned by the West Virginia Department of Administration (WVDA). Following completion of the investigation activities, the Rehabilitation Center property was transferred from WVDA to WVSU in May 2013. Although COPCs were detected in groundwater at the former Rehabilitation Center at concentrations above applicable, risk-based drinking water and vapor intrusion (VI) screening levels, current exposure pathways were incomplete (i.e., the property is supplied by municipal water, and there were no drinking water wells and no occupied structures). As a result, no further investigation activities were recommended at the former Rehabilitation Center property and the U.S. Environmental Protection Agency (USEPA) approved the recommendation in April 2014 (CH2M 2013; USEPA 2014).

Phase II, III, IV, and V investigations occurred at the adjacent WVSU property in October 2014, February 2015, June-August 2015, and January 2016, respectively. This TM documents the Phase II through Phase V investigation activities and the evaluation of the resulting data. The evaluation includes identification of potentially complete exposure scenarios and groundwater concentrations, which are compared to human health risk-based screening levels (RBSLs). Potentially complete exposure scenarios include exposures to impacted groundwater through drinking water use or via the VI pathway. Currently, the drinking water use pathway is incomplete because the WVSU property is supplied by municipal water and no drinking water wells are present on the property. Thus, there is no risk currently associated with the drinking water use pathway. With regard to VI, data indicate that the pathway is incomplete with the exception of hypothetical future residential-type use (e.g., homes, dormitories, daycare, or other) in the Phase I investigation area (Figure 1). In addition, there is also potential current or future residential exposure to an isolated groundwater sample location impact near

the eastern boundary of the WVSU property; however, this is not related to activities at the Institute Facility.

2.0 Objectives

The objectives of investigation activities are:

1. Improve characterization of the groundwater flow direction along the Institute Facility/WVSU property boundary and across the WVSU property;
2. Assess whether COPCs in groundwater are migrating above screening levels from the Institute Facility to the adjacent WVSU property;
3. Delineate the extent of COPCs in groundwater potentially originating from the Institute Facility to appropriate RBSLs; and
4. Determine whether VI may be a significant pathway for COPCs in groundwater that may have originated from the Institute Facility, migrated to the adjacent WVSU property, and has the potential to volatize from groundwater, enter occupied structures, and ultimately be inhaled as indoor air.

3.0 Constituents of Potential Concern and Risk-Based Screening Levels

COPCs for the eastern property boundary investigation were selected based on those constituents detected in groundwater samples collected along the eastern boundary of the Institute Facility (CH2M 2013). Twelve VOCs (1,1-dichloroethane [DCA], 1,1-dichloroethene [DCE], 1,2-DCA, acetone, benzene, chlorobenzene, chloroform, dichlorodifluoromethane, ethylbenzene, tetrachloroethene [PCE], toluene, and trichlorofluoromethane [TCFM, Freon-11]) and three SVOCs (1,4-dioxane [p-dioxane], isophorone, and naphthalene) were identified as COPCs for shallow and deep groundwater during Phase I of this investigation (CH2M 2013). The 12 VOCs were evaluated during all phases of the evaluation. At the request of WVSU, additional analyses were included during Phase V to assess potential impacts from fly ash fill noted in borings during Phase IV. Tables 1 through 6 list the COPC results of the data collected during all phases of the investigation; concentrations are compared to the applicable RBSLs for groundwater based on the following:

- Maximum contaminant levels (MCLs) (USEPA 2015b), where available; or
- USEPA regional screening levels (RSLs) (USEPA 2015b) for tap water based on a target carcinogenic risk = 1E-06 and an adjusted (to account for the potential for cumulative effects) target non-cancer hazard quotient (HQ) = 0.1, when no MCL is available; and
- USEPA VI screening levels (VISLs) (USEPA 2015c) for residential and commercial/industrial exposure scenarios depending on use of the potentially affected structure and based on a site-specific groundwater temperature of 19 degrees Celsius (°C). Per the West Virginia Department of Environmental Protection (WVDEP) *Voluntary Remediation and Redevelopment Act Guidance Manual* (VRRP Guidance; WVDEP 2001), a target carcinogenic risk = 1E-06 is applied to residential exposure scenarios and a target carcinogenic risk = 1E-05 is used for commercial/industrial exposures. A non-cancer HQ of 1 is used for both potential receptors (WVDEP 2001).

RBSLs are used for screening and a result above screening levels does not indicate a health risk, but rather a potential need for further investigation, evaluation, or action (USEPA 2015a).

4.0 Summary of Investigation Activities

Fieldwork conducted to satisfy the investigation objectives discussed in this TM was performed in a phased approach. Phase II took place October 20-28, 2014; Phase III was conducted February 9-12, 2015; Phase IV was performed from June 16 to August 7, 2015; and Phase V was conducted January 14-21, 2016. Groundwater sampling locations for the 2014 and 2015 investigations on the WVSU property were selected based on the results of the initial 2013 (Phase I) investigation as reported in the TM, *East Property Boundary Investigation at West Virginia State University, Bayer CropScience Institute Facility, Institute, West Virginia* (CH2M 2013) and summarized in Table 1. Groundwater sampling locations for the 2016 Phase V investigation were selected based on the results of the 2014 and 2015 Phase II through IV investigations and in consultation with WVSU and their environmental consultant.

In addition to analytical results, the following criteria were also considered in choosing sample locations: the location of existing buildings downgradient and side gradient to previous sample locations; accessibility; locations of underground utilities; and spatial distribution of sample locations. Soil and groundwater sample locations from all the phases, including the initial 2013 investigation, are depicted on Figure 2. This investigation (Phases II through V) included the following activities:

- Conducting underground utility locates and air knifing to identify and protect subsurface utilities;
- Performing continuous soil coring from ground surface to the bottom of each boring using direct-push technology (DPT) drilling equipment;
- Conducting groundwater grab sampling;
- Installing, developing, and sampling 11 monitoring wells (2015), sampling existing well MW-104, and collecting confirmation samples from new wells TW-105 and TW-106 (2016);
- Obtaining global positioning system (GPS) coordinates for soil borings/sample locations and surveying newly installed monitoring wells;
- Collecting static groundwater elevations from the 11 newly installed groundwater monitoring wells and from 10 select Institute Facility monitoring wells;
- Performing site restoration; and
- Managing investigation-derived waste (IDW).

4.1 Utility Locates

Prior to intrusive work, each boring location was cleared for utilities as follows:

- The field team met with WVSU representatives for approval of groundwater sample locations prior to drill rig mobilization. All boring locations were marked in the field.
- In advance of field mobilization, utilities were located for each proposed boring location by public utility locators through the Miss Utility West Virginia One Call and by West Virginia American Water Company. Immediately prior to mobilization, the private subcontractor Underground Detectives checked each proposed location for buried utilities using remote sensing technologies.
- The drilling subcontractor then cleared each proposed borehole location to a depth of 5 feet below ground surface (bgs) using an air knife.

4.2 Direct-Push Technology Soil Core Collection and Groundwater Grab Sampling

Soil cores and groundwater grab samples were collected as follows:

- Phase II: Soil cores were collected for lithology at four WVSU locations (INS-0465, INS-0466, INS-0467, and INS-0468); two groundwater grab samples (one shallow aquifer zone and one deep aquifer zone) were also collected at each location.
- Phase III: Soil cores were collected for lithology at three WVSU locations (INS-0469, INS-0470, and INS-0471); two groundwater grab samples (one shallow aquifer zone and one deep aquifer zone) were also collected at each location.
- Phase IV: Soil cores to evaluate lithology and one groundwater grab sample (shallow aquifer zone) were collected at four WVSU locations (TW-105, TW-106, TW-107, and TW-108). Soil cores were collected for lithology at three Institute Facility locations (TW-102, TW-103, and TW-104); two groundwater grab samples (one shallow aquifer zone and one deep aquifer zone) were also collected at each location. Additionally, one groundwater sample was collected from existing monitoring well MW-104 located at the Institute Facility.
- Phase V: Soil cores were collected to the top of bedrock to evaluate lithology at eight locations (INS-0553, INS-0554, INS-0555, INS-0559, INS-0563, INS-0566, INS-0570, and INS-0573). One deep and one shallow groundwater grab sample was collected at INS-0555; only a deep groundwater grab sample was collected at INS-0553, INS-0554, and INS-0573. Locations INS-0559, INS-0563, INS-0566, and INS-0570 were only advanced to 30 feet bgs to collect shallow groundwater grab samples.

4.2.1 Implementation

The soil cores were collected in dedicated 2-inch-diameter, 5-foot-long acetate liners, and lithological descriptions were recorded. The lithology was used to select the depths for collecting groundwater grab samples. Soil was also evaluated for impacts by visual inspection and a photoionization detector (PID). The soil boring logs for each phase of this investigation are presented as Attachment 1.

Following completion of soil cores for lithologic description, groundwater grab samples were collected in a separate borehole located immediately adjacent to the associated soil boring advanced to collect the lithology. Groundwater grab samples were collected by driving a retractable 4-foot-long stainless steel screen to the targeted groundwater sampling depth. Dedicated polyethylene tubing fitted with a check valve was lowered through the drill pipe to just above the base of the screened interval. The tubing then was repeatedly raised and lowered quickly in short strokes throughout the length of the screened interval to move groundwater up and out of the tubing. After each groundwater sample was collected, the drill rods and stainless steel screen were decontaminated before their next use.

Shallow groundwater grab samples from all phases were generally collected at depths between 14 and 38 feet bgs (within approximately 10 feet of the water table), and the deep groundwater samples were collected at depths between 35 to 58 feet bgs (slightly above the bedrock surface).

4.2.2 Groundwater Analyses

Although the majority of the investigation was conducted on the WVSU property, some samples were collected on the Institute Facility. Groundwater grab samples collected on the Institute Facility were analyzed for the list specific to the Institute Facility, which includes a larger list of compounds than the COPCs evaluated at WVSU. Groundwater analyses were conducted by phase as follows:

- Phase II and Phase IV groundwater grab samples collected on the WVSU property were analyzed for a select list specific to this investigation (COPCs listed in Section 3) using USEPA Methods SW8260B (VOCs), SW8270 (SVOCs), and SW8270C Selected Ion Monitoring (SIM) for 1,4-dioxane (Table 2).
- Phase III groundwater grab samples were analyzed for 1,4-dioxane only using USEPA Method SW8270C SIM, because 1,4-dioxane has the lowest RSL of the COPCs and behaves most conservatively in groundwater (Table 3). In addition, all other investigation specific COPCs had been delineated to below applicable screening levels to the west of these locations during Phase I and II, and therefore, only 1,4-dioxane was analyzed.
- Phase IV groundwater samples collected on the WVSU property were analyzed for the investigation-specific COPC list using USEPA Methods SW8260B (VOCs), SW8270 (SVOCs), and SW8270C SIM for 1,4-dioxane (Table 4).
- Phase V groundwater samples were analyzed for the investigation-specific COPC list (Table 5); in addition, at the request of WVSU, VOCs specific to the Institute Facility, and target compound list (TCL) SVOCs, were also analyzed (Table 6). Additionally, at the request of WVSU, Phase V locations in the vicinity of the former impoundments were analyzed for polycyclic aromatic hydrocarbons (PAHs) and RCRA metals using USEPA Methods SW8270C SIM and SW6010B, respectively (Table 6).

The samples were collected in laboratory-supplied bottles, stored on ice, and shipped using chain-of-custody procedures to Microbac Laboratories, Inc. in Marietta, Ohio (Phases II and III), and Eurofins Lancaster Laboratory, Lancaster, Pennsylvania (Phases III, IV and V). During Phase III, it was identified that the RSL for 1,4-dioxane fell between Microbac's method detection limit (MDL) and reporting limit (RL), resulting in estimated concentrations for detections above the RSL and below the RL. Therefore, Eurofins Lancaster Laboratory was used for all future analyses because its method's RL was below the RSL.

Analytical results, discussed in Section 5, are included in Tables 1 through 6 for each phase of the investigation. Data are compared to applicable screening criteria as detailed in Section 3.

4.3 Monitoring Well Installation

Eleven groundwater monitoring wells (TW-103 through TW-113) were installed by Subsurface, Inc. and Cascade Drilling in the deep portion of the aquifer between July 13 and July 29, 2015, during Phase IV (Figure 2). Monitoring well depths ranged from 45 to 58 feet bgs, slightly above bedrock surface. Each monitoring well was constructed of 2-inch-diameter Schedule 40 polyvinyl chloride (PVC) with a 10-foot 0.010-slot well screen. Number 5 sand was placed from the bottom of the boring to approximately 2 feet above the top of the well screen. A 2-foot bentonite seal was emplaced on top of the sand pack and hydrated for 1 hour, after which cement-bentonite grout was emplaced to 3 feet bgs. After a minimum of 24 hours, bentonite chips were used to fill void space after the grout settled, and flush-mount wellhead completions/well pads were installed.

4.4 Monitoring Well Development

The 11 newly installed monitoring wells were allowed to sit for at least 24 hours prior to monitoring well development. The monitoring wells were developed by surging (with a surge block) and pumping until stabilization was reached after a volume equal to water added during drilling or 10 well volumes had been removed, whichever occurred first. Field parameters (conductivity, specific conductance, temperature, pH, dissolved oxygen, redox potential, and turbidity) were monitored during development. Development water was placed into drums, staged on WVSU property, and disposed as described in Section 4.9.

4.5 Monitoring Well Sampling

The eleven newly installed monitoring wells were sampled between July 30 and August 1, 2015, with TW-105 and TW-106 resampled in January 2016 (Tables 4 and 5, and Figure 2). The groundwater samples were collected using the low-flow groundwater sampling technique. The groundwater samples collected on WVSU property were analyzed for a select list specific to this investigation (COPCs listed in Section 3) using USEPA Methods SW8260B (VOCs), SW8270 (SVOCs), and SW8270C SIM for 1,4-dioxane. The Institute Facility groundwater samples were analyzed for the Institute Facility-specific list.

The samples were collected in laboratory-supplied bottles, stored on ice, and shipped via FedEx using chain-of-custody procedures to Eurofins Lancaster Laboratory. Analytical results are discussed in Section 5. Data are compared to applicable screening criteria as detailed in Section 3.

4.6 Global Positioning System and Surveying Activities

Following sampling activities during the Phase II, III, and V field investigations, each groundwater grab sample location was surveyed using a sub-meter Leica System 1200 GPS Smart Rover or Trimble GEO XH Model 7900.

Following the Phase IV monitoring well installation, Paramount Surveying, LLC, a West Virginia Registered Professional Surveyor, surveyed the 11 monitoring wells for location and elevation using established control points on the Institute Facility.

4.7 Groundwater Level Survey

On August 7, 2015, a synoptic water level event was performed to assess groundwater flow across the Institute Facility eastern property boundary and the WVSU property. This gauging event included the 11 newly installed monitoring wells and 10 existing monitoring wells within the Institute Facility (TW-61, TW-62B, TW-64, TW-65B, TW-71B, VW-3B, VW-4B, VW-5B, VW-9B, and VW-11B). Water levels are presented in Table 7.

4.8 Site Restoration

Following sampling activities, all soil boring locations and groundwater grab sample collection points were abandoned in accordance with Section 19.3.b of the WVDEP Regulation, *Monitoring Well Design Standards*, found at Title 47 of the Code of State Regulations (CSR) Series 60 (47 CSR 60). Bentonite chips or pellets, less than 0.5 inch in diameter, were placed downhole and hydrated, and the final 6 inches were backfilled with surface material. All disturbed areas were restored to original conditions, as needed.

4.9 Investigative-Derived Waste Management

Three drums of IDW, consisting of one each of groundwater, soil, and personal protective equipment (PPE), were generated during Phase II. Two waste characterization samples (one soil and one groundwater) were collected and submitted for analysis of VOCs and SVOCs; the soil characterization sample was also submitted for total RCRA metals as required by the disposal facility. Samples were analyzed for USEPA Method SW8260B (VOCs), USEPA Method SW8270 (SVOCs), USEPA Method 6010B (arsenic, barium, cadmium, chromium, lead, and silver), USEPA Method 6020 (selenium), and USEPA Method 7470A (mercury). Based on a review of the analytical results, the IDW was characterized as non-hazardous. All waste was transported offsite following the work and disposed of at an approved facility in accordance with state and federal regulations.

Four drums of IDW (one groundwater, one soil, one soil containing fly ash, and one PPE) were generated during Phase III. All IDW was previously characterized as non-hazardous, except one soil drum that

contained suspected fly ash fill material. A waste characterization sample for the fly ash soil drum was collected and submitted for analysis of toxicity characteristic leaching procedure (TCLP) metals and 1,4-dioxane. Samples were analyzed for USEPA Method 6010B (arsenic, barium, cadmium, chromium, lead, and silver), USEPA Method 6020 (selenium), USEPA Method 7470A (mercury), and USEPA Method SW8270C SIM for 1,4-dioxane. Based on a review of the analytical results, the fly ash soil IDW was characterized as non-hazardous. All waste was transported offsite following the work and disposed of at an approved facility in accordance with state and federal regulations.

Three roll-off containers of soil/PPE IDW and 20 drums of liquid IDW were generated during Phase IV. Waste characterization samples were not necessary during this phase because the previous waste characterization results were deemed representative for profiling and waste disposal. In addition, no visual, olfactory, or PID indications of gross impacts were observed. All soil in roll-off containers were disposed of at an approved facility in accordance with state and federal regulations. The drums of liquid IDW were disposed of through the process sewers to the Institute Facility's onsite wastewater treatment unit (WWTU).

Six drums of soil/PPE IDW and three drums of liquid IDW were generated during Phase V. Waste characterization sampling was not necessary for the soil/PPE drums because the previous waste characterization results were deemed representative for profiling and waste disposal. In addition, no visual, olfactory, or PID indications of gross impacts were observed. The three drums of liquid IDW were sampled and submitted for analysis of VOCs and SVOCs. Based on a review of the analytical results, the IDW was characterized as non-hazardous. All waste was transported offsite following the work and disposed of at an approved facility in accordance with state and federal regulations.

4.10 Data Quality Evaluation

The CH2M project chemist validated the Phase II through Phase IV data and Environmental Standards, Inc. validated the Phase V data. The data were validated using the precision, accuracy, representativeness, completeness, and comparability (PARCC parameter) criteria outlined in the *Dow WVO Program Quality Assurance Project* Plan (CH2M 2012). The laboratory reports and comprehensive data validation reports are provided in Attachments 2 and 3, respectively. The following findings were noted:

- Some results were excluded due to dilutions and/or re-extractions to prevent redundancy of the data. This is not indicative of a quality assurance (QA)/quality control (QC) exceedance. Excluded results should not be used in the project decisions. This does not generate a data gap.
- J-qualified results are treated as detects at the reported concentration; however, the data user should understand the results are "estimated." The J-qualified results for this data set were the result of QA/QC exceedances in hold time and/or continuing calibration verifications (CCV). J-qualified data are fully available for use and do not present a significant negative impact on project decisions with the exception of the dichlorodifluoromethane result in sample TW106-GW-011416. There is a greater uncertainty associated with use of the estimated result from this sample because the reported concentration (17 micrograms per liter [µg/L]) is near the RBSL (20 µg/L).
- R-qualified results are rejected for project use due to serious deficiencies in the ability of the laboratory to analyze the sample and meet the QC criteria. The non-detected results in samples TW104-GW01-06252015, MW104-GW01-07112015, 0566-GW01-011916, 0555-GW02-012116, and 0555-GW02-012116D were rejected for project use and flagged as unusable by the validator because of significantly low recoveries of surrogate and/or matrix spike/matrix spike duplicates (MS/MSD) associated with Method SW8270C; however, the analytes which were rejected were not detected in other samples collected during the investigation and were not expected,

particularly in relation to activities at the Institute Facility. In addition, the analytes that were rejected were only analyzed at the request of WVSU and were not necessary to meet the investigation objectives for the RCRA Corrective Action evaluation. The rejected data were ultimately not used in the evaluation.

- UJ-qualified results are treated as non-detects at the reporting limit; however, the reporting limits are estimated and may or may not represent the actual limit necessary to accurately and precisely measure the analyte in the sample. UJ-qualified data were the result of QA/QC exceedances in hold time, initial calibration verifications (ICVS) and/or CCVs. UJ-qualified data are fully available for use and do not present a significant negative impact on project decisions.

- K-qualified results are treated as detects at the reported concentration; however, the reported concentrations are considered "estimated" with a high bias. K-qualified data were the result of QA/QC exceedances in the LCS/LCSD and/or surrogates. K-qualified data are fully available for use and do not present a significant negative impact on project decisions.

- L-qualified results are treated as detects at the reported concentration; however, the reported concentrations are considered "estimated" with a low bias. L-qualified data were the result of QA/QC exceedances in the LCS/LCSDs and/or MS/MSDs. L-qualified data are fully available for use and do not present a significant negative impact on project decisions with the exception of the 1,1-DCE result in sample TW106-GW-073115. There is a greater uncertainty associated with use of the estimated result with the low bias from this sample because the reported concentration (5L µg/L) is near the RBSL (7 µg/L).

- UL-qualified results are treated as non-detects at the reporting limit; however, the reporting limit is considered "estimated" with a low bias. UL-qualified data were the result of QA/QC exceedances in the LCS/LCSDs, surrogates and/or MS/MSDs. UL-qualified data are fully available for use and do not present a significant negative impact on project decisions.

Overall, with the exception of the rejected data, data quality is acceptable and the results may be used in project decisions taking into consideration the potential biases and validation flags applied to the data set.

5.0 Investigation Results

5.1 Hydrogeology

Alluvial deposits generally ranging from 45 to 58 feet thick associated with the Kanawha River underlie the investigation area (Figures 3A and 3B). The alluvial deposits consist of interbedded gravel, sand, silt, and clay atop gravel and clayey sandstone bedrock. Generally, the coarser material (sand and gravel) is found immediately atop the bedrock surface and finer-grained material (fine sand, silt, and clay) is found throughout the rest of the alluvial deposits. A silty sandy clay to sandy silty clay layer, varying from approximately 5 to 30 feet in thickness, is evident through the middle of the alluvial deposits and separates coarser-grained sand/silty sand units above and below it. This clay layer is thicker at the northern end of the investigation area and at the southern end adjacent to the Kanawha River (Figure 3A). Fill material is generally found in the uppermost 5 feet; however, in some locations, fill is much more extensive and found as deep as approximately 30 feet bgs as noted in boring INS-0470 (Attachment 1). These areas of thick fill contain significant thicknesses of fly ash.

Figures 4 and 5 show the thickness of the clay and permeable aquifer materials (sand and gravel), respectively, in plan view at the Institute Facility as well as on the WVSU property. As noted at the Institute Facility, the silt/clay is generally thickest along the bank of the Kanawha River (Figure 4). One

exception to this is at INS-0469, which is located within a historical surface water drainage channel that discharged to the river (Figure 6). Figure 5 indicates that the permeable aquifer materials are thicker (30 to 40 feet) along the property boundary between WVSU and the Institute Facility. This feature appears to influence the groundwater flow patterns, as discussed in the following paragraphs.

Groundwater across the investigation area is found at approximately 20 feet bgs. Along the property line between the Institute Facility and WVSU (hereafter referred to as the property line), groundwater flow is to the south-southeast from the Institute Facility toward the WVSU property (Figure 7). On the WVSU property, groundwater flow becomes southerly, with flow heading toward the Kanawha River.

The direction of groundwater flow along the property line appears to be influenced by the following factors:

- The presence of thicker, more permeable sands, creating a preferential flow path in the deeper aquifer toward the Kanawha River (Figures 4 and 5); and
- A historical surface water drainage identified on the southern half of the WVSU property that discharged to the Kanawha River (Figure 6).

Groundwater flow appears to generally follow the alignment of the historical drainage and the underlying thicker, more permeable aquifer at depth.

5.2 Historical Surface Water Features

Historically, there were two surface water drainages within the investigation area that were filled in over the years, as indicated on historical aerial photographs and topographic maps presented in Attachment 4. These features are important because they appear to influence subsurface groundwater flow patterns and may influence the presence of COPCs detected in groundwater. In the late 1950s, the northwestern drainage was impounded and two surface water bodies are noted in a historical photograph from 1955 (Attachment 4). The extent of these former features is shown on Figure 6. The artificial impoundments and local drainage were filled in by 1971 based on a historical aerial photograph (Attachment 4).

Fill material was reported in the boring log for eight of the borings installed in the southern portion of the WVSU property. Accumulations of fly ash up to 27 feet were reported in TW-107 and 26 feet in INS-470.

5.3 Groundwater

During the investigations that occurred between 2013 and 2016, 28 groundwater samples and five field duplicates (FDs) were collected from the shallow interval, and 37 groundwater samples and eight FDs were collected from the deep interval. Analytical data, including that from Phase I, are presented in Tables 1 through 6 and compared to applicable screening criteria presented in Section 3.

5.3.1 Shallow Interval COPC Results

In the shallow interval, the site-specific COPCs that exceed applicable RBSLs comprise the following:

VOCs

- 1,1-DCA was detected at concentrations above the tap water RSL of 2.8 µg/L at two locations (3.29 µg/L at INS-0385 and 6.44 µg/L at INS-0467). INS-0385 is located along the property line between the Institute Facility and WVSU, and INS-0467 is located downgradient adjacent to the Kanawha River. No results were greater than the VISLs.

- Chlorobenzene exceeded the MCL of 100 µg/L at one location with a detection of 165 µg/L at INS-0388, which is located downgradient of the Institute Facility. The boring log from this location also noted the presence of fill and fly ash. No results were greater than the VISLs.
- Chloroform was detected above the residential VISL at two locations (4.46 µg/L at INS-0385 and 12.2 µg/L at INS-0390) during Phase I (Table 1; CH2M 2013); however, concentrations were not detected above the MCL (80 µg/L) or the commercial/industrial VISL (46 µg/L). There is no residential use in this area. Results of all subsequent sampling (Phases II through V) indicate that chloroform was not detected above the RBSLs.
- PCE was detected above the MCL of 5 µg/L and above the residential VISL of 21 µg/L at INS-0555 (30 µg/L) during Phase V of the investigation. Concentrations were not greater than the commercial/industrial VISL (340 µg/L) and PCE was not detected at any other sample location.
- The remaining COPCs, 1,1-DCE, 1,2-DCA, acetone, benzene, dichlorodifluoromethane, ethylbenzene, toluene, and TCFM, were not detected above their respective RBSLs (i.e., MCLs/RSLs and/or VISLs, as applicable) at any location sampled.

SVOCs

- 1,4-Dioxane exceeded its tap water RSL (0.46 µg/L) in 21 of 28 locations. The distribution of concentrations is illustrated on Figure 8. Two plumes of elevated concentrations (an order of magnitude greater than the RSL) are evident. From INS-0385, the plume extends from the Institute Facility onto the WVSU property, migrating southward to the Kanawha River. From INS-0470, on the southeastern portion of the WVSU property, the plume includes the locations where the former drainage was filled with fly ash and other fill materials such as wood and plastic, and migrates to the Kanawha River. Two isolated areas of elevated concentrations are localized around INS-0563 and VW-3A. No sample concentrations were greater than the VISLs.
- Naphthalene exceeded its tap water RSL of 0.17 µg/L in one location with a concentration of 7 µg/L at TW-107. This location is on the eastern portion of the WVSU property where fill and fly ash were noted in the boring log. No results were greater than the VISLs.
- Isophorone was not detected above MCLs/RSLs at any location sampled; there is no VISL for isophorone because it is not sufficiently volatile.

5.3.2 Deep Interval COPC Results

In the deep interval, the site-specific COPCs that exceeded applicable screening levels comprise the following:

VOCs

- 1,1-DCA exceeded the tap water RSL of 2.8 µg/L at four locations ranging from 2.96 µg/L at INS-0390 to 12.3 µg/L at INS-0389. The distribution of 1,1-DCA is illustrated on Figure 9. The 1,1-DCA plume is located on the southern portion of the property line and extends south toward the Kanawha River.
- Benzene was detected at 5.3 µg/L and chlorobenzene was detected at 205 µg/L at INS-0388, exceeding respective MCLs of 5 and 100 µg/L. INS-0388 is located in the southwestern portion of the WVSU property. Chlorobenzene exceeded the MCL in the shallow zone at this boring, which noted the presence of fill and fly ash.
- Dichlorodifluoromethane had three detections above the tap water RSL of 20 µg/L at two locations. Two samples collected at different times at INS-0389 exceeded the screening level: 57.2L µg/L in March 2013 and 43K µg/L in May 2013. In addition, TW-104 exceeded the screening level with a concentration of 22 µg/L in June 2015, but was below the RSL with a concentration of 1 µg/L in

August 2015. INS-0389 is located near the southwest corner of the WVSU property near the Kanawha River and TW-104 is located in the central portion of the Institute Facility along the property boundary with WVSU.

- The remaining COPCs of 1,1-DCE, 1,2-DCA, acetone, chloroform, ethylbenzene, PCE, and toluene were not detected in the investigation area above their respective RBSLs (i.e., MCL or RSL, as applicable).

SVOCs

- 1,4-Dioxane exceeded the tap water RSL (0.46 µg/L) at 22 locations. The exceedances ranged from 0.48 µg/L (INS-0555) to 36.7 µg/L (INS-0390). The distribution of 1,4-dioxane in the deep interval is illustrated on Figure 10. The plume extends from the property line to the south-southeast toward the Kanawha River.
- Naphthalene exceeded its RSL of 0.17 µg/L with a concentration of 13 µg/L at TW-107. This location is on the eastern extent of the WVSU property where fill and fly ash were noted in the boring log.
- Isophorone was not detected above its RSL at any location sampled.

5.3.3 Additional Analytical Results

In Phase V, additional analyses were conducted at the request of WVSU. Although these compounds are not related to impacts from the Institute Facility and the associated RCRA Corrective Actions, they are presented in Table 6 and compared to the RBSLs summarized in Section 3. The additional analyses were performed as follows:

- VOCs (via USEPA Method SW8260B) at all Phase V locations;
- TCL SVOCs (via USEPA Method SW8270C) at all Phase V shallow interval locations, and deep interval locations INS-0574 and INS-0555;
- PAHs (via USEPA Method SW8270C SIM) at shallow locations (INS-0559, INS-0563, INS-0566, and INS-0570), and
- RCRA Metals (via USEPA Method SW6010B) at shallow locations (INS-0559, INS-0563, INS-0566, and INS-0570).

Shallow Interval Results. None of the PAHs was detected in any of the samples. Only two metals were detected: barium and arsenic. Arsenic exceeded the MCL at the two locations where it was detected, INS-0559 and INS-0563. The only organic compounds detected were trichloroethene (TCE) and ethyl ether at INS-0555 and INS-0559, respectively. TCE results were greater than the residential VISL but less than the commercial/industrial VISL and MCL.

Deep Interval Results. The only additional analyte detected in the deep interval is 2-butanone at INS-0554. The detected concentration does not exceed RBSLs.

5.3.4 Distribution of COPCs

To assess the distribution of COPCs across the investigation area, Figures 11 and 12 show the relative concentration of detected chemicals or chemical groups at each sample location in the shallow and deep intervals, respectively. Relative concentrations were calculated by first summing the concentrations of all detected COPCs within each well (total). The relative percent of each compound or compound group (sum of concentrations within each group) was then calculated by dividing the individual compound or group concentration by the total. The compound groupings are as follows:

- Petroleum hydrocarbons – benzene, ethylbenzene, and toluene
- Chlorinated hydrocarbons – 1,1-DCA, 1,1-DCE, 1,2-DCA, chlorobenzene, and PCE

- Fluorocarbon products – dichlorodifluoromethane and TCFM
- 1,4-Dioxane
- Naphthalene
- Chloroform

This presentation creates a "fingerprint" of the types of COPCs present and facilitates an assessment of the similarities and differences between the potential sources affecting each of the sampled locations. The distribution of the different COPC fingerprints is described by area, as follows:

- Northern Area – Defined by the area north of the former impoundments and north of TW-108.
- Southwestern Area– Defined by locations INS-0385, INS-0387, INS-0388, INS-0389, INS-0390, INS-0467, TW-109, and TW-110; this area corresponds with the Phase I investigation area.
- Southeastern Area – Defined by the area east of INS-0467 and south of INS-0566 and TW-107, and bounded by TW-113 and INS-0471 to the east; this area generally corresponds with the Phase II and Phase III investigation areas.

In the shallow interval in the northern portion of the Institute Facility, 1,4-dioxane (TW-102) and chlorinated hydrocarbons (TW-104) are the only constituents detected upgradient of the WVSU property. No COPCs were detected downgradient of TW-102 and TW-104 on Northern Area of the WVSU property as represented by results at TW 105 and TW-106. PCE and TCE were detected in the shallow interval at INS-0555 in the Northern Area. These COPCs were not detected in any other samples collected on the WVSU property. In the deep interval, 1,4-dioxane and fluorocarbon products are observed on the northern portion of the Institute Facility at TW-104. The same chemical mixture is noted downgradient at TW-106 in the Northern Area of the WVSU property.

In the Southwestern Area of the WVSU property, both the shallow and deep intervals are characterized by a mix of COPCs that include chlorinated hydrocarbons, chloroform, 1,4-dioxane, fluorocarbon products, and petroleum hydrocarbons. This area of the WVSU property is the only area where this COPC fingerprint is observed. This COPC mix is consistent with the migration of COPCs southeast from the Institute Facility across the eastern boundary and towards the Kanawha River.

The shallow and deep intervals in the Southeastern Area of the WVSU property are characterized predominantly by the presence of 1,4-dioxane only with the exception that other COPCs were observed at TW-107. Only 1,4-dioxane was analyzed at INS-0469, INS-0470, and INS-0471, and as a result, the presence of other COPCs is not known and relative concentrations could not be determined at these locations. 1,4-Dioxane only was analyzed at these locations because 1) it is the most conservative of the COPCs and, therefore, is expected to migrate the furthest; and 2) all other COPCs had been delineated to below applicable screening levels hydraulically upgradient of these locations. At TW-107, naphthalene and 1,2-DCA were detected; these COPCs were not detected at any other locations on the WVSU property.

Although chloroform was not detected in any samples above the MCL, the distribution of chloroform in the deep interval is illustrated on Figure 13. This figure demonstrates the generalized flow path for COPCs originating on the Institute Facility toward the Kanawha River

5.4 Nature and Extent of Groundwater Impacts

The nature and extent of groundwater impacted by COPCs have been defined for the investigation area. The following sections describe the COPCs in groundwater by the areas defined above. The results are summarized by area because the COPC impacts in groundwater vary across the investigation area.

5.4.1 Southwestern Area

As discussed previously, in both the shallow and deep intervals, a mix of COPCs is present in the Southwestern Area that is not present elsewhere on the property. The COPCs in this area are similar to those on the adjoining portion of the Institute Facility, potentially the source for these COPCs. This is seen in Figures 11 and 12, and is also illustrated by the 1,1-DCA plume that is only present in the Southwestern Area of the WVSU property (Figure 9) as well as by the deep 1,4-dioxane plume present across this area (Figure 10). The extent of these COPCs is delineated on WVSU property.

5.4.2 Southeastern Area

COPCs in the Southeastern Area appear to be associated with a separate source from those in the Southwestern Area of the WVSU property. In the shallow interval, a mixture of naphthalene, 1,4-dioxane, and 1,2-DCA are found only at TW-107 (Figure 11). Naphthalene and 1,2-DCA are not detected in the shallow interval in any other locations on the WVSU property, and 1,4-dioxane is detected at a concentration an order of magnitude higher than in samples collected immediately west of this area. Finally, in the deep interval, a mixture of chloroform and 1,4-dioxane that is not noted elsewhere on the site is noted at TW-107 and TW-112 (Figure 12). The chloroform concentrations reported at TW-107 and TW-112 are not related to the COPCs on the Institute Facility because there are non-detect results for chloroform reported at locations between these wells and the Southwestern Area of the site were the chloroform plume is present (Figure 13). Impacts observed in the Southeastern Area do not appear to be a result of COPC migration from the Institute Facility.

5.4.3 Northern Area

There are limited impacts to groundwater in the Northern Area (approximately north of TW-108 and the former impoundment locations) compared to the Southeastern Area and Southwestern Area. 1,4-dioxane is detected in six of the 10 wells located north of TW-108 and may be related to more than one source (Figure 8). Acetone, dichlorodifluoromethane, PCE, and TCE are the only other COPCs observed in samples collected in the Northern Area. Acetone is detected well below the RBSLs in the deep interval in TW-108 and INS-0554. Dichlorodifluoromethane is only detected in TW-106 in the deep interval and is not reported above RBSLs. PCE and TCE were detected only at INS-0555, near the eastern boundary of the WVSU property (Figure 11), several hundred feet north of the former impoundments and in the immediate vicinity of the WVSU vehicle maintenance area. The presence of the PCE and TCE in the shallow interval in only one location on the eastern boundary of the WVSU property indicates a separate source not related to migration from the Institute Facility. Other COPCs present on the Institute Facility are not observed in samples collected in the Northern Area (Figure 12).

6.0 Conclusions

The results of the eastern property investigation are summarized by objective, outlined in Section 2, as follows:

- *Improve characterization of the groundwater flow direction*: The installation of groundwater monitoring wells at the WVSU property allowed the groundwater flow patterns to be assessed across the WVSU property and correlated with groundwater flow patterns on the Institute Facility. Data from the investigation indicate a southeasterly flow component of groundwater along the Institute Facility property boundary that becomes more southerly on the WVSU property with flow toward the Kanawha River. These flow patterns are influenced by the subsurface hydrogeologic conditions, and the patterns are consistent with the observed lithology.
- *Assess potential COPC migration from the Institute Facility*: The distribution of COPCs in groundwater is affected by the groundwater flow patterns and is reflected in the observed concentrations and COPC plume shapes. To illustrate these relationships, Figure 14 presents

groundwater flow patterns compared to the shallow 1,4-dioxane plume. Figure 15 illustrates the groundwater flow patterns compared to the deep 1,4-dioxane plume. Groundwater impacts on the WVSU property appear to have resulted from more than one source. Groundwater flow patterns and COPC concentrations suggest that 1,4-dioxane (shallow and deep) and 1,1-DCA (deep) plumes have potentially migrated from the Institute Facility onto the southwestern portion of the WVSU property before migrating towards the Kanawha River. One or more other sources of groundwater impact are suggested for 1,4-dioxane (shallow; Figure 14) and chloroform (deep; Figure 13) in the southeastern portion of the WVSU property.

- *Delineate COPCs to RBSLs*: The extent of the groundwater impacts in the shallow and deep intervals of the investigation area that are above the screening criteria has been delineated by the current investigation presented in Section 3. The only plumes migrating from the Institute Facility above RBSLs are 1,4-dioxane and 1,1-DCA. Based on the observed concentrations and groundwater flow patterns, another source area is present on the WVSU property as characterized by the shallow 1,4-dioxane groundwater plume, a different COPC footprint at TW-107 and TW-112, and the presence of PCE and TCE at INS-0555 only. The majority of the COPCs, other than 1,4-dioxane and 1,1-DCA, were either detected in a small number of wells that are isolated or not detected at all. Based on the available data, COPC plumes that may have originated from the Institute Facility have been defined and do not require further delineation.

  Investigate VI Potential as related to the Institute Facility: Groundwater data indicate that the VI pathway is incomplete with the exception of potential future residential-type use (e.g., homes, dormitories, daycare, or other) in the Phase I investigation area (Figure 1). As proposed in the TM *East Property Boundary Investigation at West Virginia State University* (CH2M 2013) and approved by USEPA in April 2014, an environmental covenant is proposed to address this potential future residential VI scenario in the Phase I investigation area. In addition, there is also potential current or future residential exposure to an isolated groundwater sample location impact near the eastern boundary of the WVSU property; however, this is unrelated to activities at the Institute Facility.

7.0 References

CH2M. 2012. *Dow WVO Quality Assurance Project Plan*. Prepared for Union Carbide Corporation. May.

CH2M. 2013. *East Property Boundary Investigation at West Virginia State University*. Bayer CropScience Institute Facility, Institute, West Virginia. August.

U.S. Environmental Protection Agency (USEPA). 2014. Personal communication from William Wentworth/USEPA RPM to Jerome Cibrik/UCC Remediation Leader. RE: The East Property Boundary Investigation. April 29.

U.S. Environmental Protection Agency (USEPA). 2015a. *Regional Screening Table User's Guide*. Available at http://www.epa.gov/risk/regional-screening-table-users-guide-november-2015. November.

U.S. Environmental Protection Agency (USEPA). 2015b. *Regional Screening Levels*. Available at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/ index.htm. November.

U.S. Environmental Protection Agency (USEPA). 2015c. *Office of Soil Waste and Emergency Response (OSWER) Vapor Intrusion Assessment Vapor Intrusion Screening Level (VISL) Calculator*, Version 3.4. November.

West Virginia Department of Environmental Protection (WVDEP). 2001. *Voluntary Remediation and Redevelopment Act Guidance Manual*. Version 2.1.

Tables

Figures

Attachments

Tables

Table 1. Summary of Phase I Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

					Shallow Interval Results					
				Location>>	INS-0385		INS-0387		INS-0388	
				Sample ID>>	0385-GW01-031513		0387-GW01-031413		0388-GW01-031413	
				Depth (ft)>>	27 - 32		30 - 35		32 - 37	
				Sample Date>>	3/15/2013		3/14/2013		3/14/2013	
		RBSLs								
Analyte[a]	Units	MCL / RSL	Commercial/ Industrial VISL	Residential VISL		RL		RL		RL
SVOC										
1,4-Dioxane (p-Dioxane)	µg/L	0.46	180000	4000	**19.9**	10.9	1.1 UJ	1.1	**2.87 J**	1.1
Isophorone	µg/L	78	NA	NA	5.43 U	5.43	5.49 U	5.43	5.56 U	5.49
Naphthalene	µg/L	0.17	310	7.2	5.43 U	5.43	5.49 U	5.43	5.56 U	5.49
VOC										
1,1-Dichloroethane	µg/L	2.8	430	9.9	**3.29**	1	1 U	1	1 U	1
1,1-Dichloroethene	µg/L	7	1000	240	1 U	1	1 U	1	1 U	1
1,2-Dichloroethane	µg/L	5	130	30	1 U	1	1 U	1	1 U	1
Acetone	µg/L	1400	120000000	29000000	5 U	5	5 UL	5	5 U	5
Benzene	µg/L	5	92	2.1	1 U	1	1 U	1	1 U	1
Chlorobenzene	µg/L	100	2400	570	1 U	1	1 U	1	**165**	1
Chloroform	µg/L	80	46	1.1	**4.46**	1	1 U	1	1 U	1
Dichlorodifluoromethane	µg/L	20	41	9.9	1 U	1	1 U	1	1 U	1
Ethylbenzene	µg/L	700	220	49	1 U	1	1 U	1	1 U	1
Tetrachloroethene	µg/L	5	340	21	1 U	1	1 U	1	1 U	1
Toluene	µg/L	1000	110000	26000	1 U	1	1 U	1	1 U	1
Trichlorofluoromethane	µg/L	520	NA	NA	**8.55**	1	1 U	1	1 U	1

Table 1. Summary of Phase I Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

					Shallow Interval Results			
				Location>>	INS-0389		INS-0390	
				Sample ID>>	0389-GW01-031313		0390-GW01-031213	
				Depth (ft)>>	32 - 37		32 - 37	
				Sample Date>>	3/13/2013		3/12/2013	
		RBSLs						
Analyte[a]	Units	MCL / RSL	Commercial/ Industrial VISL	Residential VISL		RL		RL
SVOC								
1,4-Dioxane (p-Dioxane)	µg/L	0.46	180000	4000	**3.71 J**	1.09	**7.08 J**	1.11
Isophorone	µg/L	78	NA	NA	5.43 U	5.43	5.56 U	5.56
Naphthalene	µg/L	0.17	310	7.2	5.43 U	5.43	5.56 U	5.56
VOC								
1,1-Dichloroethane	µg/L	2.8	430	9.9	**1.88**	1	**2.67**	1
1,1-Dichloroethene	µg/L	7	1000	240	1 U	1	**1.45**	1
1,2-Dichloroethane	µg/L	5	130	30	1 U	1	1 U	1
Acetone	µg/L	1400	120000000	29000000	5 U	5	5 U	5
Benzene	µg/L	5	92	2.1	1 U	1	**1.76**	1
Chlorobenzene	µg/L	100	2400	570	1 U	1	**64.8**	1
Chloroform	µg/L	80	46	1.1	1 U	1	**12.2**	1
Dichlorodifluoromethane	µg/L	20	41	9.9	1 U	1	1 U	1
Ethylbenzene	µg/L	700	220	49	1 U	1	1 U	1
Tetrachloroethene	µg/L	5	340	21	1 U	1	1 U	1
Toluene	µg/L	1000	110000	26000	1 U	1	1 U	1
Trichlorofluoromethane	µg/L	520	NA	NA	**3.64**	1	**26.5**	1

Table 1. Summary of Phase I Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results							
			INS-0385 0385-GW02-031513 37 - 42		INS-0387 0387-GW-051613 35 - 45		INS-0387 0387-GW-051613D 35 - 45		INS-0388 0388-GW-051713 33.5 - 43.5	
Analyte[a]	**Units**	**MCL / RSL**	3/15/2013	RL	5/16/2013	RL	5/16/2013	RL	5/17/2013	RL
SVOC										
1,4-Dioxane (p-Dioxane)	µg/L	0.46	**11.6**	10.5	--		--		--	
Isophorone	µg/L	78	5.26 U	5.26	--		--		--	
Naphthalene	µg/L	0.17	5.26 U	5.26	--		--		--	
VOC										
1,1-Dichloroethane	µg/L	2.8	**3.98**	1	1 U	1	1 U	1	1 U	1
1,1-Dichloroethene	µg/L	7	1 U	1	1 U	1	1 U	1	1 U	1
1,2-Dichloroethane	µg/L	5	1 U	1	1 U	1	1 U	1	1 U	1
Acetone	µg/L	1400	5 U	5	5 UL	5	5 UL	5	5 U	5
Benzene	µg/L	5	1 U	1	1 U	1	1 U	1	1 U	1
Chlorobenzene	µg/L	100	1 U	1	1 U	1	1 U	1	**205**	1
Chloroform	µg/L	80	**24.6**	1	1 U	1	1 U	1	**2.25**	1
Dichlorodifluoromethane	µg/L	20	**2.09**	1	1 UJ	1	1 UJ	1	1 U	1
Ethylbenzene	µg/L	700	1 U	1	1 U	1	1 U	1	1 U	1
Tetrachloroethene	µg/L	5	1 U	1	1 U	1	1 U	1	1 U	1
Toluene	µg/L	1000	1 U	1	1 U	1	1 U	1	1 U	1
Trichlorofluoromethane	µg/L	520	**52.1**	1	1 U	1	1 U	1	**3.11**	1

Table 1. Summary of Phase I Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results							
			INS-0387 0387-GW02-031413 40 - 45		INS-0387 0387-GW02-031413D 40 - 45		INS-0388 0388-GW02-031413 42 - 47		INS-0389 0389-GW-051613 35-45	
Analyte[a]	**Units**	**MCL / RSL**	3/14/2013	RL	3/14/2013	RL	3/14/2013	RL	5/16/2013	RL
SVOC										
1,4-Dioxane (p-Dioxane)	µg/L	0.46	1.1 UJ	1.1	1.12 UJ	1.12	**5.46 J**	1.09	- -	
Isophorone	µg/L	78	5.49 U	5.49	5.62 U	5.62	5.43 U	5.43	- -	
Naphthalene	µg/L	0.17	5.49 U	5.49	5.62 U	5.62	5.43 U	5.43	- -	
VOC										
1,1-Dichloroethane	µg/L	2.8	**1.26**	1	**1.24**	1	**1.76**	1	**6.18**	1
1,1-Dichloroethene	µg/L	7	1 U	1	1 U	1	1 U	1	**1.03**	1
1,2-Dichloroethane	µg/L	5	1 U	1	1 U	1	1 U	1	1 U	1
Acetone	µg/L	1400	5 UL	5	5 UL	5	5 U	5	5 U	5
Benzene	µg/L	5	1 U	1	1 U	1	**5.3**	1	1 U	1
Chlorobenzene	µg/L	100	1 U	1	1 U	1	1 U	1	1 U	1
Chloroform	µg/L	80	**1.78**	1	**1.56**	1	**29.9**	1	**29.6**	1
Dichlorodifluoromethane	µg/L	20	1 U	1	1 U	1	1 U	1	**43 K**	1
Ethylbenzene	µg/L	700	1 U	1	1 U	1	1 U	1	1 U	1
Tetrachloroethene	µg/L	5	1 U	1	1 U	1	1 U	1	1 U	1
Toluene	µg/L	1000	1 U	1	1 U	1	1 U	1	1 U	1
Trichlorofluoromethane	µg/L	520	**2.29**	1	**2.05**	1	**49.5**	1	**141**	1

Table 1. Summary of Phase I Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results					
			INS-0389 0389-GW02-031313 42 - 47		INS-0390 0390-GW-051713 35 - 45		INS-0390 0390-GW02-031213 42 - 47	
Analyte[a]	**Units**	**MCL / RSL**	3/13/2013	RL	5/17/2013	RL	3/12/2013	RL
SVOC								
1,4-Dioxane (p-Dioxane)	µg/L	0.46	**4.83 J**	1.08	- -		**36.7**	10.3
Isophorone	µg/L	78	5.38 U	5.38	- -		5.15 U	5.15
Naphthalene	µg/L	0.17	5.38 U	5.38	- -		5.15 U	5.15
VOC								
1,1-Dichloroethane	µg/L	2.8	**12.3**	1	**2.96**	1	**1.51**	1
1,1-Dichloroethene	µg/L	7	**1.15**	1	**1.4**	1	1 U	1
1,2-Dichloroethane	µg/L	5	1 U	1	1 U	1	1 U	1
Acetone	µg/L	1400	5 U	5	5 U	5	5 U	5
Benzene	µg/L	5	1 U	1	**1.67**	1	1 U	1
Chlorobenzene	µg/L	100	1 U	1	**37.7**	1	1 U	1
Chloroform	µg/L	80	**13.8**	1	**13**	1	1 U	1
Dichlorodifluoromethane	µg/L	20	**57.2 L**	1	1 U	1	1 UJ	1
Ethylbenzene	µg/L	700	1 U	1	1 U	1	1 U	1
Tetrachloroethene	µg/L	5	1 U	1	1 U	1	1 U	1
Toluene	µg/L	1000	1 U	1	1 U	1	1 U	1
Trichlorofluoromethane	µg/L	520	**25.6 L**	1	**30.5**	1	1 U	1

Notes:

Risk-based screening levels (RBSLs) included for comparison are:

The maximum contaminant level (MCL), where available, or the USEPA regional screening level (RSL; November 2015) for tap water based on a target carcinogenic risk = 1E-06 and an adjusted non-cancer hazard quotient of 0.1; and

The USEPA vapor intrusion screening level (VISL; November 2015), based on a target carcinogenic risk = 1E-05 for the commercial/industrial receptor and 1E-06 for the residential receptor, a target non-cancer hazard index = 1, and an average, regional groundwater temperature = 19 degrees Celsius, is compared to shallow interval results.

Bold results indicate detected concentrations.

Underlined results indicate shallow concentrations detected above the Residential VISL (no concentrations are greater than commercial/industrial VISLs).

Grey shaded result indicates concentration detected above the MCL/RSL.

µg/L = micrograms per liter

NA = Not applicable

J flag indicates the reported concentration is estimated.

K flag indicates the reported concentration is biased high.

UL flag indicates analyte was analyzed for but was not detected. The quantitation limit may be biased low.

U flag indicates the constituent was not detected above the reporting detection limit (RL).

UJ flag indicates the constituent was not detected above an estimated reporting detection limit.

Table 2. Summary of Phase II Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

					Shallow Interval Results							
				Location>>	INS-0465		INS-0466		INS-0467		INS-0468	
				Sample ID>>	0465-GW01-102714		0466-GW01-102814		0467-GW01-102114		0468-GW01-102414	
				Depth (ft)>>	23 - 27		22 - 26		32 - 36		32 - 36	
				Sample Date>>	10/27/2014		10/28/2014		10/21/2014		10/24/2014	
		RBSLs										
Analyte[a]	Units	MCL / RSL	Commercial/Industrial VISL	Residential VISL		RL		RL		RL		RL
SVOC												
1,4-Dioxane (p-Dioxane)	µg/L	0.46	180000	4000	**4.64**	1.15	1.05 U	1.05	**5.05**	1.08	**2.52**	1.11
Isophorone	µg/L	78	NA	NA	5.75 U	5.75	5.26 U	5.26	5.38 UJ	5.38	2.78 U	5.56
Naphthalene	µg/L	0.17	310	7.2	5.75 U	5.75	5.26 U	5.26	5.38 UJ	5.38	2.78 U	5.56
VOC												
1,1-Dichloroethane	µg/L	2.8	430	9.9	1 U	1	1 U	1	**6.44**	1	0.125 U	1
1,1-Dichloroethene	µg/L	7	1000	240	1 U	1	1 U	1	**2.73**	1	0.5 U	1
1,2-Dichloroethane	µg/L	5	130	30	1 U	1	1 U	1	1 U	1	0.25 U	1
Acetone	µg/L	1400	120000000	29000000	5 UJ	5	5 UJ	5	5 U	5	2.5 UJ	5
Benzene	µg/L	5	92	2.1	1 U	1	1 U	1	1 U	1	0.125 U	1
Chlorobenzene	µg/L	100	2400	570	1 U	1	1 U	1	1 U	1	0.125 U	1
Chloroform	µg/L	80	46	1.1	1 U	1	1 U	1	**1.07**	1	0.125 U	1
Dichlorodifluoromethane	µg/L	20	41	9.9	1 UJ	1	1 UJ	1	1 UJ	1	0.25 UJ	1
Ethylbenzene	µg/L	700	220	49	1 U	1	1 U	1	1 U	1	0.25 U	1
Tetrachloroethene	µg/L	5	340	21	1 U	1	1 U	1	1 U	1	0.25 U	1
Toluene	µg/L	1000	110000	26000	1 U	1	1 U	1	1 U	1	0.25 U	1
Trichlorofluoromethane	µg/L	520	NA	NA	1 U	1	1 U	1	1 U	1	0.25 U	1

Table 2. Summary of Phase II Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results									
		Location>>	INS-0465		INS-0466		INS-0466		INS-0467		INS-0468	
		Sample ID>>	0465-GW02-102714		0466-GW02-102814		0466-GW02-102814D		0467-GW02-102114		0468-GW02-102414	
		Depth (ft)>>	44 - 47		42 - 46		42 - 46		42 - 46		41 - 45	
		Sample Date>>	10/27/2014		10/27/2014		10/28/2014		10/21/2014		10/24/2014	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL		RL		RL
SVOC												
1,4-Dioxane (p-Dioxane)	µg/L	0.46	**14.7**	11.1	**7.02**	1.08	**5.58**	1.12	**22.2 K**	10.8	**3.61**	1.27
Isophorone	µg/L	78	5.56 U	5.56	5.38 U	5.38	5.62 U	5.62	5.38 UJ	5.38	3.16 UL	6.33
Naphthalene	µg/L	0.17	5.56 U	5.56	5.38 U	5.38	5.62 U	5.62	5.38 UJ	5.38	3.16 UL	6.33
VOC												
1,1-Dichloroethane	µg/L	2.8	1 U	1	1 U	1	1 U	1	1 U	1	0.125 U	1
1,1-Dichloroethene	µg/L	7	1 U	1	1 U	1	1 U	1	1 U	1	0.5 U	1
1,2-Dichloroethane	µg/L	5	1 U	1	1 U	1	1 U	1	1 U	1	0.25 U	1
Acetone	µg/L	1400	5 UJ	5	5 UJ	5	5 UJ	5	5 U	5	2.5 UJ	5
Benzene	µg/L	5	1 U	1	1 U	1	1 U	1	1 U	1	0.125 U	1
Chlorobenzene	µg/L	100	1 U	1	1 U	1	1 U	1	1 U	1	0.125 U	1
Chloroform	µg/L	80	1 U	1	1 U	1	1 U	1	1 U	1	0.125 U	1
Dichlorodifluoromethane	µg/L	20	1 UJ	1	1 UJ	1	1 UJ	1	1 UJ	1	0.25 UJ	1
Ethylbenzene	µg/L	700	1 U	1	1 U	1	1 U	1	1 U	1	0.25 U	1
Tetrachloroethene	µg/L	5	1 U	1	1 U	1	1 U	1	1 U	1	0.25 U	1
Toluene	µg/L	1000	1 U	1	1 U	1	1 U	1	1 U	1	0.25 U	1
Trichlorofluoromethane	µg/L	520	1 U	1	1 U	1	1 U	1	1 U	1	0.25 U	1

Notes:

Risk-based screening levels (RBSLs) included for comparison are:

The maximum contaminant level (MCL), where available, or the USEPA regional screening level (RSL; November 2015) for tap water based on a target carcinogenic risk = 1E-06 and an adjusted non-cancer hazard quotient of 0.1; and

The USEPA vapor intrusion screening level (VISL; November 2015), based on a target carcinogenic risk = 1E-05 for the commercial/industrial receptor and 1E-06 for the residential receptor, a target non-cancer hazard index = 1, and an average, regional groundwater temperature = 19 degrees Celsius, is compared to shallow interval results.

Bold results indicate detected concentrations.

No shallow interval concentrations are greater than the residential or commercial/industrial VISL.

Grey shaded results indicate concentration detected above the MCL/RSL.

µg/L = micrograms per liter

NA = Not applicable

U flag indicates the constituent was not detected above the reporting detection limit (RL).

UJ flag indicates the constituent was not detected above an estimated reporting detection limit.

K flag indicates the reported concentration is biased high.

UL flag indicates analyte was analyzed for but was not detected. The quantitation limit may be biased low.

Table 3. Summary of Phase III Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

					Shallow Interval Results						
		RBSLs			Location>>	INS-0469		INS-0469		INS-0470	
					Sample ID>>	0469-GW01-021015		0469-GW01-021015S		0470-GW01-021115	
			Commercial		Depth (ft)>>	33 - 37		33 - 37		18 - 22	
			/Industrial	Residential	Sample Date>>	2/10/2015		2/10/2015		2/11/2015	
Analyte[a]	Units	MCL / RSL	VISL	VISL			RL		RL		RL
SVOC											
1,4-Dioxane (p-Dioxane)	µg/L	0.46	180000	4000		**3.46**	1.19	**2.3**	0.11	**5.19**	1.33

					Shallow Interval Results						
		RBSLs			Location>>	INS-0470		INS-0471		INS-0471	
					Sample ID>>	0470-GW01-021115S		0471-GW01-021215		0471-GW01-021215D	
			Commercial		Depth (ft)>>	18 - 22		34 - 38		34 - 38	
			/Industrial	Residential	Sample Date>>	2/11/2015		2/12/2015		2/12/2015	
Analyte[a]	Units	MCL / RSL	VISL	VISL			RL		RL		RL
SVOC											
1,4-Dioxane (p-Dioxane)	µg/L	0.46	180000	4000		**4.2**	0.5	**5.13**	1.06	**5.41**	1.06

					Shallow Interval Results				
		RBSLs			Location>>	INS-0471		INS-0471	
					Sample ID>>	0471-GW01-021215DS		0471-GW01-021215S	
			Commercial		Depth (ft)>>	34 - 38		34 - 38	
			/Industrial	Residential	Sample Date>>	2/12/2015		2/12/2015	
Analyte[a]	Units	MCL / RSL	VISL	VISL			RL		RL
SVOC									
1,4-Dioxane (p-Dioxane)	µg/L	0.46	180000	4000		**4.4**	0.11	**4.4**	0.12

Table 3. Summary of Phase III Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results					
Deep Interval Results		**Location>>**	INS-0470		INS-0470		INS-0471	
		Sample ID>>	0470-GW02-021115		0470-GW02-021115S		0471-GW02-021215S	
		Depth (ft)>>	46 - 50		46 - 50		44 - 48	
		Sample Date>>	2/11/2015		2/11/2015		2/12/2015	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL
SVOC								
1,4-Dioxane (p-Dioxane)	µg/L	0.46	**3.48**	1.08	**2.3**	0.11	**3.3**	0.11

Notes:

Risk-based screening levels (RBSLs) included for comparison are:

The maximum contaminant level (MCL), where available, or the USEPA regional screening level (RSL; November 2015) for tap water based on a target carcinogenic risk = 1E-06

The USEPA vapor intrusion screening level (VISL; November 2015), based on a target carcinogenic risk = 1E-05 for the commercial/industrial receptor and 1E-06

for the residential receptor, a target non-cancer hazard index = 1, and an average, regional groundwater temperature = 19 degrees Celsius, is

Bold results indicate detected concentrations.

No shallow interval concentration is greater than the residential or commercial/industrial VISL.

Grey shaded results indicate concentration detected above the MCL/RSL.

µg/L = micrograms per liter

Table 4. Summary of Phase IV Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

					Shallow Interval Results					
				Location>>	MW-104		TW-102		TW-103	
				Sample ID>>	MW104-GW-071115		TW102-GW01-070915		TW103-GW01-070815	
				Depth (ft)>>	23-33		8.5-12.5		18-22	
				Sample Date>>	7/11/2015		7/9/2015		7/8/2015	
		RBSLs								
Analyte[a]	**Units**	**MCL / RSL**	**Commercial /Industrial VISL**	**Residential VISL**		RL		RL		RL
SVOC										
1,4-Dioxane (p-Dioxane)	µg/L	0.46	180000	4000	**0.85**	0.21	**0.59 L**	0.21	0.21 U	0.21
Isophorone	µg/L	78	NA	NA	1 U	1	1 U	1	1 U	1
Naphthalene	µg/L	0.17	310	7.2	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
VOC										
1,1-Dichloroethane	µg/L	2.8	430	9.9	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,1-Dichloroethene	µg/L	7	1000	240	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2-Dichloroethane	µg/L	5	130	30	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Acetone	µg/L	1400	120000000	29000000	5 U	5	5 U	5	**6**	5
Benzene	µg/L	5	92	2.1	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chlorobenzene	µg/L	100	2400	570	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chloroform	µg/L	80	46	1.1	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Dichlorodifluoromethane	µg/L	20	41	9.9	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Ethylbenzene	µg/L	700	220	49	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Tetrachloroethene	µg/L	5	340	21	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Toluene	µg/L	1000	110000	26000	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trichlorofluoromethane	µg/L	520	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5

Table 4. Summary of Phase IV Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

					Shallow Interval Results					
				Location>>	TW-104		TW-105		TW-106	
				Sample ID>>	TW104-GW01-062515		TW105-GW01-062515		TW106-GW01-062515	
				Depth (ft)>>	16-20		17-21		17-21	
				Sample Date>>	6/25/2015		6/25/2015		6/25/2015	
		RBSLs								
Analyte[a]	**Units**	**MCL / RSL**	**Commercial /Industrial VISL**	**Residential VISL**		RL		RL		RL
SVOC										
1,4-Dioxane (p-Dioxane)	µg/L	0.46	180000	4000	0.22 U	0.22	0.21 U	0.21	0.23 U	0.23
Isophorone	µg/L	78	NA	NA	1 U	1	1 U	1	1 U	1
Naphthalene	µg/L	0.17	310	7.2	0.5 U	0.5	0.5 U	0.5	0.6 U	0.6
VOC										
1,1-Dichloroethane	µg/L	2.8	430	9.9	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,1-Dichloroethene	µg/L	7	1000	240	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2-Dichloroethane	µg/L	5	130	30	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Acetone	µg/L	1400	120000000	29000000	5 U	5	5 U	5	5 U	5
Benzene	µg/L	5	92	2.1	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chlorobenzene	µg/L	100	2400	570	**12**	0.5	0.5 U	0.5	0.5 U	0.5
Chloroform	µg/L	80	46	1.1	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Dichlorodifluoromethane	µg/L	20	41	9.9	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Ethylbenzene	µg/L	700	220	49	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Tetrachloroethene	µg/L	5	340	21	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Toluene	µg/L	1000	110000	26000	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trichlorofluoromethane	µg/L	520	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5

Table 4. Summary of Phase IV Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

					Shallow Interval Results					
				Location>>	TW-107		TW-108		TW-108	
				Sample ID>>	TW107-GW01-070715		TW108-GW01-070815		TW108-GW01-070815D	
				Depth (ft)>>	17-21		17-21		17-21	
				Sample Date>>	7/7/2015		7/8/2015		7/8/2015	
		RBSLs								
Analyte[a]	**Units**	**MCL / RSL**	**Commercial /Industrial VISL**	**Residential VISL**		RL		RL		RL
SVOC										
1,4-Dioxane (p-Dioxane)	µg/L	0.46	180000	4000	**2.2 L**	0.29	**3.5**	0.2	**4.1**	0.2
Isophorone	µg/L	78	NA	NA	1 U	1	1 UL	1	1 U	1
Naphthalene	µg/L	0.17	310	7.2	**7**	0.7	0.5 UL	0.5	0.5 U	0.5
VOC										
1,1-Dichloroethane	µg/L	2.8	430	9.9	2.5 U	2.5	0.5 U	0.5	0.5 U	0.5
1,1-Dichloroethene	µg/L	7	1000	240	2.5 U	2.5	0.5 U	0.5	0.5 U	0.5
1,2-Dichloroethane	µg/L	5	130	30	**4.7**	2.5	0.5 U	0.5	0.5 U	0.5
Acetone	µg/L	1400	120000000	29000000	25 U	5	5 U	5	5 U	5
Benzene	µg/L	5	92	2.1	2.5 U	2.5	0.5 U	0.5	0.5 U	0.5
Chlorobenzene	µg/L	100	2400	570	2.5 U	2.5	0.5 U	0.5	0.5 U	0.5
Chloroform	µg/L	80	46	1.1	2.5 U	2.5	0.5 U	0.5	0.5 U	0.5
Dichlorodifluoromethane	µg/L	20	41	9.9	2.5 U	2.5	0.5 U	0.5	0.5 U	0.5
Ethylbenzene	µg/L	700	220	49	2.5 U	2.5	0.5 U	0.5	0.5 U	0.5
Tetrachloroethene	µg/L	5	340	21	2.5 U	2.5	0.5 U	0.5	0.5 U	0.5
Toluene	µg/L	1000	110000	26000	2.5 U	2.5	0.5 U	0.5	0.5 U	0.5
Trichlorofluoromethane	µg/L	520	NA	NA	2.5 U	2.5	0.5 U	0.5	0.5 U	0.5

Table 4. Summary of Phase IV Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results							
		Location>>	TW-102		TW-103		TW-103		TW-104	
		Sample ID>>	TW102-GW02-070915		TW103-GW02-070815		TW103-GW-080115		TW104-GW02-062515	
		Depth (ft)>>	38-42		48-52		47-57		46-56	
		Sample Date>>	7/9/2015		7/8/2015		8/1/2015		6/25/2015	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL		RL
SVOC										
1,4-Dioxane (p-Dioxane)	µg/L	0.46	0.2 U	0.2	0.2 U	0.2	0.2 U	0.2	**8.5**	0.2
Isophorone	µg/L	78	1 U	1	1 U	1	1 U	1	1 U	1
Naphthalene	µg/L	0.17	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
VOC										
1,1-Dichloroethane	µg/L	2.8	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,1-Dichloroethene	µg/L	7	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2-Dichloroethane	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Acetone	µg/L	1400	**9.2**	5	5 U	5	5 U	5	5 U	5
Benzene	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chlorobenzene	µg/L	100	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chloroform	µg/L	80	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Dichlorodifluoromethane	µg/L	20	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	**22**	0.5
Ethylbenzene	µg/L	700	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Tetrachloroethene	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Toluene	µg/L	1000	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trichlorofluoromethane	µg/L	520	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5

Table 4. Summary of Phase IV Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results							
		Location>>	TW-104		TW-105		TW-106		TW-107	
		Sample ID>>	TW104-GW-080115		TW105-GW-073115		TW106-GW-080115		TW107-GW-073015	
		Depth (ft)>>	45-55		48-58		48-58		42-52	
		Sample Date>>	8/1/2015		7/31/2015		8/1/2015		7/30/2015	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL		RL
SVOC										
1,4-Dioxane (p-Dioxane)	µg/L	0.46	**3.7**	0.2	0.2 U	0.2	**2**	0.2	**0.3**	0.2
Isophorone	µg/L	78	1 U	1	1 U	1	1 U	1	1 U	1
Naphthalene	µg/L	0.17	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	**13**	0.5
VOC										
1,1-Dichloroethane	µg/L	2.8	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,1-Dichloroethene	µg/L	7	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2-Dichloroethane	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Acetone	µg/L	1400	5 U	5	5 U	5	5 U	5	5 U	5
Benzene	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chlorobenzene	µg/L	100	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chloroform	µg/L	80	0.5 U	0.5	**3.1**	0.5	0.5 U	0.5	**0.7**	0.5
Dichlorodifluoromethane	µg/L	20	**1**	0.5	0.5 U	0.5	**17**	0.5	0.5 U	0.5
Ethylbenzene	µg/L	700	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Tetrachloroethene	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Toluene	µg/L	1000	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trichlorofluoromethane	µg/L	520	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5

Table 4. Summary of Phase IV Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results							
		Location>>	TW-108		TW-109		TW-110		TW-111	
		Sample ID>>	TW108-GW-073115		TW109-GW-073115		TW110-GW-073115		TW111-GW-080115	
		Depth (ft)>>	45-55		48-58		44-54		41.5-51.5	
		Sample Date>>	7/31/2015		7/31/2015		7/31/2015		8/1/2015	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL		RL
SVOC										
1,4-Dioxane (p-Dioxane)	µg/L	0.46	**19**	1.1	**8**	0.21	**19**	1.1	**32**	2
Isophorone	µg/L	78	1 U	1	1 U	1	1 U	1	1 U	1
Naphthalene	µg/L	0.17	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
VOC										
1,1-Dichloroethane	µg/L	2.8	0.5 U	0.5	**0.6**	0.5	**6.9**	0.5	0.5 U	0.5
1,1-Dichloroethene	µg/L	7	0.5 U	0.5	0.5 U	0.5	**5 L**	0.5	0.5 U	0.5
1,2-Dichloroethane	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 UL	0.5	0.5 U	0.5
Acetone	µg/L	1400	**44**	5	**39**	5	5 U	5	5 U	5
Benzene	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 UL	0.5	0.5 U	0.5
Chlorobenzene	µg/L	100	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chloroform	µg/L	80	0.5 U	0.5	**2.6**	0.5	**1.1 L**	0.5	0.5 U	0.5
Dichlorodifluoromethane	µg/L	20	0.5 U	0.5	**1.4**	0.5	**0.6**	0.5	0.5 U	0.5
Ethylbenzene	µg/L	700	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Tetrachloroethene	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Toluene	µg/L	1000	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trichlorofluoromethane	µg/L	520	0.5 U	0.5	0.5 U	0.5	**2**	0.5	0.5 U	0.5

Table 4. Summary of Phase IV Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results			
		Location>>	TW-112		TW-113	
		Sample ID>>	TW112-GW-073115		TW113-GW-073015	
		Depth (ft)>>	35-45		41-51	
		Sample Date>>	7/31/2015		7/30/2015	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL
SVOC						
1,4-Dioxane (p-Dioxane)	µg/L	0.46	**3**	0.2	**3**	0.2
Isophorone	µg/L	78	1 U	1	1 U	1
Naphthalene	µg/L	0.17	0.5 U	0.5	0.5 U	0.5
VOC						
1,1-Dichloroethane	µg/L	2.8	0.5 U	0.5	0.5 U	0.5
1,1-Dichloroethene	µg/L	7	0.5 U	0.5	0.5 U	0.5
1,2-Dichloroethane	µg/L	5	0.5 U	0.5	0.5 U	0.5
Acetone	µg/L	1400	5 U	5	5 U	5
Benzene	µg/L	5	0.5 U	0.5	0.5 U	0.5
Chlorobenzene	µg/L	100	0.5 U	0.5	0.5 U	0.5
Chloroform	µg/L	80	**0.5**	0.5	0.5 U	0.5
Dichlorodifluoromethane	µg/L	20	0.5 U	0.5	0.5 U	0.5
Ethylbenzene	µg/L	700	0.5 U	0.5	0.5 U	0.5
Tetrachloroethene	µg/L	5	0.5 U	0.5	0.5 U	0.5
Toluene	µg/L	1000	0.5 U	0.5	0.5 U	0.5
Trichlorofluoromethane	µg/L	520	0.5 U	0.5	0.5 U	0.5

Notes:

Risk-based screening levels (RBSLs) included for comparison are:

The maximum contaminant level (MCL), where available, or the USEPA regional screening level (RSL; November 2015) for tap water based on a target carcinogenic risk = 1E-06 and an adjusted non-cancer hazard quotient of 0.1; and

The USEPA vapor intrusion screening level (VISL; November 2015), based on a target carcinogenic risk = 1E-05 for the commercial/industrial receptor and 1E-06 for the residential receptor, a target non-cancer hazard index = 1, and an average, regional groundwater temperature = 19 degrees Celsius, is compared to shallow interval results only.

Bold results indicate detected concentrations.

No shallow interval concentration is greater than the residential or commercial/industrial VISL.

Grey shaded results indicate concentration detected above the MCL/RSL.

µg/L = micrograms per liter

NA = Not applicable

L flag indicates the reported concentration is biased low.

U flag indicates the constituent was not detected above the reporting detection limit.

UL flag indicates analyte was analyzed for but was not detected. The quantitation limit may be biased low.

Table 5. Summary of Phase V Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

				Shallow Interval Results									
			Location>>	INS-0555		INS-0559		INS-0563		INS-0566		INS-0570	
			Sample ID>>	0555-GW01-012116		0559-GW01-011916		0563-GW01-011916		0566-GW01-011916		0570-GW01-011916	
			Depth (ft)>>	22-26		21-25		22-26		18-22		18-22	
			Sample Date>>	1/21/2016		1/19/2016		1/19/2016		1/19/2016		1/19/2016	
		RBSLs											
Analyte[a]	Units	MCL / RSL	Commercial /Industrial VISL	Residential VISL		RL		RL		RL		RL	
SVOC													
1,4-Dioxane (p-Dioxane)	µg/L	0.46	180000	4000	0.20 U	0.21	**0.49**	0.2	**7.7**	0.2	**3.4**	0.2	0.20 U	0.2
Isophorone	µg/L	78	NA	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
Naphthalene	µg/L	0.17	310	7.2	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
VOC													
1,1-Dichloroethane	µg/L	2.8	430	9.9	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,1-Dichloroethene	µg/L	7	1000	240	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2-Dichloroethane	µg/L	5	130	30	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Acetone	µg/L	1400	120000000	29000000	5 U	5	5 U	5	5 U	5	5 U	5	0.5 U	5
Benzene	µg/L	5	92	2.1	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chlorobenzene	µg/L	100	2400	570	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chloroform	µg/L	80	46	1.1	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Dichlorodifluoromethane	µg/L	20	41	9.9	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Ethylbenzene	µg/L	700	220	49	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Tetrachloroethene	µg/L	5	340	21	**30**	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Toluene	µg/L	1000	110000	26000	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trichlorofluoromethane	µg/L	520	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5

Table 5. Summary of Phase V Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results							
		Location>>	INS-0553		INS-0554		INS-0555		INS-0555	
		Sample ID>>	0553-GW02-011816		0554-GW02-011816		0555-GW02-012116		0555-GW02-012116D	
		Depth (ft)>>	51-55		51-55		47-51		47-51	
		Sample Date>>	1/18/2016		1/18/2016		1/21/2016		1/21/2016	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL		RL
SVOC										
1,4-Dioxane (p-Dioxane)	µg/L	0.46	**0.24**	0.21	0.22 U	0.21	**0.48**	0.21	**0.47**	0.21
Isophorone	µg/L	78	1 U	1	1 U	1	R	1	R	1
Naphthalene	µg/L	0.17	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
VOC										
1,1-Dichloroethane	µg/L	2.8	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,1-Dichloroethene	µg/L	7	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2-Dichloroethane	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Acetone	µg/L	1400	5 U	5	**22**	5	5 U	5	5 U	5
Benzene	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chlorobenzene	µg/L	100	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chloroform	µg/L	80	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Dichlorodifluoromethane	µg/L	20	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Ethylbenzene	µg/L	700	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Tetrachloroethene	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Toluene	µg/L	1000	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trichlorofluoromethane	µg/L	520	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5

Table 5. Summary of Phase V Groundwater Data

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results									
		Location>>	INS-0573		INS-0574		TW-105		TW-105		TW-106	
		Sample ID>>	0573-GW01-012116		0574-GW01-012116		TW105-GW-011416		TW105-GW-011416D		TW106-GW-011416	
		Depth (ft)>>	46-50		47-51		48-58		48-58		48-58	
		Sample Date>>	1/21/2016		1/21/2016		1/14/2016		1/14/2016		1/14/2016	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL		RL		RL
SVOC												
1,4-Dioxane (p-Dioxane)	µg/L	0.46	**0.57**		**2.5**		0.21 U	0.21	0.2 U	0.2	**1.7**	0.2
Isophorone	µg/L	78	1 U		1 U		1 U	1	1 U	1	1 U	1
Naphthalene	µg/L	0.17	0.5 U		0.5 U		0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
VOC												
1,1-Dichloroethane	µg/L	2.8	0.5 U		0.5 U		0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,1-Dichloroethene	µg/L	7	0.5 U		0.5 U		0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2-Dichloroethane	µg/L	5	0.5 U		0.5 U		0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Acetone	µg/L	1400	5.0 U		5.0 U		5 U	5	5 U	5	5 U	5
Benzene	µg/L	5	0.5 U		0.5 U		0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chlorobenzene	µg/L	100	0.5 U		0.5 U		0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chloroform	µg/L	80	0.5 U		0.5 U		0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Dichlorodifluoromethane	µg/L	20	0.5 U		0.5 U		0.5 U	0.5	0.5 U	0.5	**17 J**	0.5
Ethylbenzene	µg/L	700	0.5 U		0.5 U		0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Tetrachloroethene	µg/L	5	0.5 U		0.5 U		0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Toluene	µg/L	1000	0.5 U		0.5 U		0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trichlorofluoromethane	µg/L	520	0.5 U		0.5 U		0.5 U	0.5	0.5 U	0.5	0.5 U	0.5

Notes:

Risk-based screening levels (RBSLs) included for comparison are:

The maximum contaminant level (MCL), where available, or the USEPA regional screening level (RSL; November 2015) for tap water based on a target carcinogenic risk = 1E-06 and an adjusted non-cancer hazard quotient of 0.1; and

The USEPA vapor intrusion screening level (VISL; November 2015), based on a target carcinogenic risk = 1E-05 for the commercial/industrial receptor and 1E-06 for the residential receptor, a target non-cancer hazard index = 1, and an average, regional groundwater temperature = 19 degrees Celsius, is compared to shallow interval results.

Bold results indicate detected concentrations.

No shallow interval concentration is greater than the commercial/industrial VISL.

Grey shaded results indicate concentration detected above the MCL/RSL.

Underlined results indicate shallow concentrations detected above the Residential VISL.

µg/L = micrograms per liter

NA = Not applicable

R flag indicates the data were not of sufficient quality for reporting.

U flag indicates the constituent was not detected above the reporting detection limit.

Table 6. Summary of Additional Analyses - Phase V

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

					Shallow Interval Results									
				Location>>	INS-0555		INS-0559		INS-0563		INS-0566		INS-0570	
				Sample ID>>	0555-GW01-012116		0559-GW01-011916		0563-GW01-011916		0566-GW01-011916		0570-GW01-011916	
				Depth (ft)>>	22-26		21-25		22-26		18-22		18-22	
				Sample Date>>	1/21/2016		1/19/2016		1/19/2016		1/19/2016		1/19/2016	
		RBSLs												
Analyte[a]	Units	MCL / RSL	Commercial/ Industrial VISL	Residential VISL		RL		RL		RL		RL		RL
VOC														
1,1,2,2-Tetrachloroethane	µg/L	0.076	200	4.6	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,1,2-Trichloroethane	µg/L	5	36	7.2	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2,4-Trimethylbenzene	µg/L	15	180	43	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2-Dichloropropane	µg/L	5	140	3.3	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,3,5-Trimethylbenzene	µg/L	120	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,3-Dichlorobenzene	µg/L	NA	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,4-Dichlorobenzene	µg/L	75	170	3.8	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
2-Butanone	µg/L	5600	13000000	3000000	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
2-Hexanone	µg/L	38	49000	12000	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
4-Methyl-2-pentanone	µg/L	6300	3300000	780000	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
Bromodichloromethane	µg/L	80	51	1.2	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Bromomethane	µg/L	7.5	89	21	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Carbon disulfide	µg/L	810	6600	1600	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
Carbon tetrachloride	µg/L	5	24	0.54	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chloromethane	µg/L	190	1300	310	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
cis-1,2-Dichloroethylene	µg/L	70	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Dibromochloromethane	µg/L	80	18	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Methylene chloride	µg/L	5	25000	970	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Styrene	µg/L	100	56000	13000	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trans-1,2-Dichloroethylene	µg/L	100	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trichloroethylene	µg/L	5	29	1.6	***2.3***	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Vinyl chloride	µg/L	2	29	0.24	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Xylenes, Total	µg/L	10000	2300	550	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
SVOC														
2,4,5-Trichlorophenol	µg/L	1200	NA	NA	1 U	1	1 U	1	1 U	1	R	1	1 U	1
2,4,6-Trichlorophenol	µg/L	4.1	NA	NA	1 U	1	1 U	1	1 U	1	R	1	1 U	1
2,4-Dichlorophenol	µg/L	46	NA	NA	1 U	1	1 U	1	1 U	1	R	1	1 U	1
2,4-Dimethylphenol	µg/L	360	NA	NA	1 U	1	1 U	1	1 U	1	R	1	1 U	1
2,4-Dinitrophenol	µg/L	39	NA	NA	31 UJ	31	30 U	30	30 U	30	R	30	30 U	30
2,4-Dinitrotoluene	µg/L	0.24	NA	NA	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
2,6-Dinitrotoluene	µg/L	0.049	NA	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
2-Chloronaphthalene	µg/L	750	NA	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
2-Chlorophenol	µg/L	91	NA	NA	1 U	1	1 U	1	1 U	1	R	1	1 U	1
2-Methylnaphthalene	µg/L	36	NA	NA	0.5 U	0.5	0.052 U	0.052	0.052 U	0.052	0.051 U	0.051	0.052 U	0.052

Table 6. Summary of Additional Analyses - Phase V

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

		Shallow Interval Results													
				Location>>	INS-0555		INS-0559		INS-0563		INS-0566		INS-0570	
				Sample ID>>	0555-GW01-012116		0559-GW01-011916		0563-GW01-011916		0566-GW01-011916		0570-GW01-011916	
				Depth (ft)>>	22-26		21-25		22-26		18-22		18-22	
				Sample Date>>	1/21/2016		1/19/2016		1/19/2016		1/19/2016		1/19/2016	
		RBSLs												
Analyte[a]	Units	MCL / RSL	Commercial/ Industrial VISL	Residential VISL		RL		RL		RL		RL		RL
SVOC (continued)														
2-Methylphenol	µg/L	930	NA	NA	1 U	1	1 U	1	1 U	1	R	1	1 U	1
2-Nitroaniline	µg/L	190	NA	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
2-Nitrophenol	µg/L	NA	NA	NA	1 U	1	1 U	1	1 U	1	R	1	1 U	1
3,3'-Dichlorobenzidine	µg/L	0.13	NA	NA	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
3-Nitroaniline	µg/L	NA	NA	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
4,6-Dinitro-2-methylphenol	µg/L	1.5	NA	NA	15 UJ	15	15 U	15	15 U	15	R	15	15 U	15
4-Bromophenyl phenyl ether	µg/L	NA	NA	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
4-Chloro-3-methylphenol	µg/L	1400	NA	NA	1 U	1	1 U	1	1 U	1	R	1	1 U	1
4-Chloroaniline	µg/L	0.37	NA	NA	4 U	4	4 U	4	4 U	4	4 U	4	4 U	4
4-Chlorophenyl phenyl ether	µg/L	NA	NA	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
4-Nitroaniline	µg/L	3.8	NA	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
4-Nitrophenol	µg/L	42	0.0000011	NA	31 U	31	30 U	30	30 U	30	R	30	30 U	30
Acenaphthene	µg/L	530	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Acenaphthylene	µg/L	NA	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Anthracene	µg/L	1800	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Benzo (a) anthracene	µg/L	0.012	NA	NA	0.5 U	0.5	0.052 U	0.052	0.052 U	0.052	0.051 U	0.052	0.052 U	0.052
Benzo (a) pyrene	µg/L	0.2	NA	NA	0.5 U	0.5	0.052 U	0.5	0.052 U	0.5	0.051 U	0.5	0.052 U	0.5
Benzo (b) fluoranthene	µg/L	0.034	NA	NA	0.5 U	0.5	0.052 U	0.5	0.052 U	0.5	0.051 U	0.5	0.052 U	0.5
Benzo (g,h,i) perylene	µg/L	NA	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Benzo(k)fluoranthene	µg/L	0.34	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Bis (2-chloroethoxy) methane	µg/L	59	NA	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
Bis (2-chloroethyl) ether	µg/L	0.014	850	20	0.052 U	0.052	0.051 U	0.051	0.051 U	0.051	0.05 U	0.051	0.051 UJ	0.051
Bis (2-chloroisopropyl) ether	µg/L	710	610	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
Bis (2-ethylhexyl) phthalate	µg/L	6	NA	NA	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
Butyl benzylphthalate	µg/L	16	NA	NA	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
Chrysene	µg/L	3.4	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Di-n-butylphthalate	µg/L	900	NA	NA	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
Di-n-octylphthalate	µg/L	200	NA	NA	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
Dibenzo (a,h) anthracene	µg/L	0.0034	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Dibenzofuran	µg/L	7.9	NA	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
Diethyl phthalate	µg/L	15000	NA	NA	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
Dimethyl phthalate	µg/L	NA	NA	NA	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
Ethyl ether	µg/L	3900	NA	NA	0.5 U	0.5	**3 K**	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Fluoranthene	µg/L	800	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5

Table 6. Summary of Additional Analyses - Phase V

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

		Shallow Interval Results													
				Location>>	INS-0555		INS-0559		INS-0563		INS-0566		INS-0570	
				Sample ID>>	0555-GW01-012116		0559-GW01-011916		0563-GW01-011916		0566-GW01-011916		0570-GW01-011916	
				Depth (ft)>>	22-26		21-25		22-26		18-22		18-22	
				Sample Date>>	1/21/2016		1/19/2016		1/19/2016		1/19/2016		1/19/2016	
		RBSLs												
Analyte[a]	Units	MCL / RSL	Commercial/ Industrial VISL	Residential VISL		RL		RL		RL		RL		RL
SVOC (continued)														
Fluorene	µg/L	290	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Hexachlorobenzene	µg/L	1	0.65	0.15	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Hexachlorobutadiene	µg/L	0.14	21	0.47	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
Hexachlorocyclopentadiene	µg/L	50	5.2	1.2	15 U	15	15 U	15	15 U	15	15 U	15	15 U	15
Hexachloroethane	µg/L	0.33	110	2.6	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
Indeno (1,2,3-c,d) pyrene	µg/L	0.034	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
n-Nitrosodi-n-propylamine	µg/L	0.011	NA	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
n-Nitrosodiphenylamine	µg/L	12	NA	NA	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
Nitrobenzene	µg/L	0.14	5000	110	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
p-Cresol	µg/L	1900	NA	NA	1 U	1	1 U	1	1 U	1	R	1	1 U	1
Pentachlorophenol	µg/L	1	NA	NA	5 U	5	5 U	5	5 U	5	R	5	5 U	5
Phenanthrene	µg/L	NA	NA	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Phenol	µg/L	5800	NA	NA	1 U	1	1 U	1	1 U	1	R	1	1 U	1
Pyrene	µg/L	120	NA	NA	0.5 U	0.5	0.052 U	0.052	0.052 U	0.052	0.051 U	0.051	0.052 U	0.052
Metal														
Arsenic, dissolved	mg/L	0.01	NA	NA	- -		**0.0643**	0.02	**0.131**	0.02	0.02 U	0.02	0.02 U	0.02
Barium, dissolved	mg/L	2	NA	NA	- -		**0.562**	0.005	**0.668**	0.005	**1.58**	0.005	**0.0901**	0.005
Cadmium, dissolved	mg/L	0.005	NA	NA	- -		0.005 U	0.005	0.005 U	0.005	0.005 U	0.005	0.005 U	0.005
Chromium, dissolved	mg/L	0.1	NA	NA	- -		0.015 U	0.015	0.015 U	0.015	0.015 U	0.015	0.015 U	0.015
Lead, dissolved	mg/L	0.015	NA	NA	- -		0.015 U	0.015	0.015 U	0.015	0.015 U	0.015	0.015 U	0.015
Mercury, dissolved	mg/L	0.002	0.0061	0.0015	- -		0.0002 U	2E-04	0.0002 U	2E-04	0.0002 U	2E-04	0.0002 U	2E-04
Selenium, dissolved	mg/L	0.05	NA	NA	- -		0.02 U	0.02	0.02 U	0.02	0.02 U	0.02	0.02 U	0.02
Silver, dissolved	mg/L	0.094	NA	NA	- -		0.005 U	0.005	0.005 U	0.005	0.005 U	0.005	0.005 U	0.005

Table 6. Summary of Additional Analyses - Phase V

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results							
		Location>>	INS-0553		INS-0554		INS-0555		INS-0555	
		Sample ID>>	0553-GW02-011816		0554-GW02-011816		0555-GW02-012116		0555-GW02-012116D	
		Depth (ft)>>	51-55		51-55		47-51		47-51	
		Sample Date>>	1/18/2016		1/18/2016		1/21/2016		1/21/2016	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL		RL
VOC										
1,1,2,2-Tetrachloroethane	µg/L	0.076	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,1,2-Trichloroethane	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2,4-Trimethylbenzene	µg/L	15	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2-Dichloropropane	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,3,5-Trimethylbenzene	µg/L	120	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,3-Dichlorobenzene	µg/L	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,4-Dichlorobenzene	µg/L	75	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
2-Butanone	µg/L	5600	5 U	5	**5.5**	5	5 U	5	5 U	5
2-Hexanone	µg/L	38	5 U	5	5 U	5	5 U	5	5 U	5
4-Methyl-2-pentanone	µg/L	6300	5 U	5	5 U	5	5 U	5	5 U	5
Bromodichloromethane	µg/L	80	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Bromomethane	µg/L	7.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Carbon disulfide	µg/L	810	1 U	1	1 U	1	1 U	1	1 U	1
Carbon tetrachloride	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chloromethane	µg/L	190	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
cis-1,2-Dichloroethylene	µg/L	70	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Dibromochloromethane	µg/L	80	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Methylene chloride	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Styrene	µg/L	100	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trans-1,2-Dichloroethylene	µg/L	100	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trichloroethylene	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Vinyl chloride	µg/L	2	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Xylenes, Total	µg/L	10000	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
SVOC										
2,4,5-Trichlorophenol	µg/L	1200	- -		- -		1 U	1	1 U	1
2,4,6-Trichlorophenol	µg/L	4.1	- -		- -		1 U	1	1 U	1
2,4-Dichlorophenol	µg/L	46	- -		- -		1 U	1	1 U	1
2,4-Dimethylphenol	µg/L	360	- -		- -		1 U	1	1 U	1
2,4-Dinitrophenol	µg/L	39	- -		- -		31 U	31	31 U	31
2,4-Dinitrotoluene	µg/L	0.24	- -		- -		R	5	R	5
2,6-Dinitrotoluene	µg/L	0.049	- -		- -		R	1	R	1
2-Chloronaphthalene	µg/L	750	- -		- -		R	1	R	1
2-Chlorophenol	µg/L	91	- -		- -		1 U	1	1 U	1
2-Methylnaphthalene	µg/L	36	- -		- -		R	0.5	R	0.5

Table 6. Summary of Additional Analyses - Phase V

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results							
		Location>>	INS-0553		INS-0554		INS-0555		INS-0555	
		Sample ID>>	0553-GW02-011816		0554-GW02-011816		0555-GW02-012116		0555-GW02-012116D	
		Depth (ft)>>	51-55		51-55		47-51		47-51	
		Sample Date>>	1/18/2016		1/18/2016		1/21/2016		1/21/2016	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL		RL
SVOC (continued)										
2-Methylphenol	µg/L	930	- -		- -		1 U	1	1 U	1
2-Nitroaniline	µg/L	190	- -		- -		R	1	R	1
2-Nitrophenol	µg/L	NA	- -		- -		1 U	1	1 U	1
3,3'-Dichlorobenzidine	µg/L	0.13	- -		- -		R	5	R	5
3-Nitroaniline	µg/L	NA	- -		- -		R	1	R	1
4,6-Dinitro-2-methylphenol	µg/L	1.5	- -		- -		16 U	16	15 U	15
4-Bromophenyl phenyl ether	µg/L	NA	- -		- -		R	1	R	1
4-Chloro-3-methylphenol	µg/L	1400	- -		- -		1 U	1	1 U	1
4-Chloroaniline	µg/L	0.37	- -		- -		R	4	R	4
4-Chlorophenyl phenyl ether	µg/L	NA	- -		- -		R	1	R	1
4-Nitroaniline	µg/L	3.8	- -		- -		R	1	R	1
4-Nitrophenol	µg/L	42	- -		- -		31 U	31	31 U	31
Acenaphthene	µg/L	530	- -		- -		R	0.5	R	0.5
Acenaphthylene	µg/L	NA	- -		- -		R	0.5	R	0.5
Anthracene	µg/L	1800	- -		- -		R	0.5	R	0.5
Benzo (a) anthracene	µg/L	0.012	- -		- -		R	0.5	R	0.5
Benzo (a) pyrene	µg/L	0.2	- -		- -		R	0.5	R	0.5
Benzo (b) fluoranthene	µg/L	0.034	- -		- -		R	0.5	R	0.5
Benzo (g,h,i) perylene	µg/L	NA	- -		- -		R	0.5	R	0.5
Benzo(k)fluoranthene	µg/L	0.34	- -		- -		R	0.5	R	0.5
Bis (2-chloroethoxy) methane	µg/L	59	- -		- -		R	1	R	1
Bis (2-chloroethyl) ether	µg/L	0.014	- -		- -		0.052 U	0.05	0.051 U	0.05
Bis (2-chloroisopropyl) ether	µg/L	710	- -		- -		R	1	R	1
Bis (2-ethylhexyl) phthalate	µg/L	6	- -		- -		R	5	R	5
Butyl benzylphthalate	µg/L	16	- -		- -		R	5	R	5
Chrysene	µg/L	3.4	- -		- -		R	0.5	R	0.5
Di-n-butylphthalate	µg/L	900	- -		- -		R	5	R	5
Di-n-octylphthalate	µg/L	200	- -		- -		R	5	R	5
Dibenzo (a,h) anthracene	µg/L	0.0034	- -		- -		R	0.5	R	0.5
Dibenzofuran	µg/L	7.9	- -		- -		R	1	R	1
Diethyl phthalate	µg/L	15000	- -		- -		R	5	R	5
Dimethyl phthalate	µg/L	NA	- -		- -		R	5	R	5
Ethyl ether	µg/L	3900	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Fluoranthene	µg/L	800	- -		- -		R	0.5	R	0.5

Table 6. Summary of Additional Analyses - Phase V

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results							
		Location>>	INS-0553		INS-0554		INS-0555		INS-0555	
		Sample ID>>	0553-GW02-011816		0554-GW02-011816		0555-GW02-012116		0555-GW02-012116D	
		Depth (ft)>>	51-55		51-55		47-51		47-51	
		Sample Date>>	1/18/2016		1/18/2016		1/21/2016		1/21/2016	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL		RL
SVOC (continued)										
Fluorene	µg/L	290	- -		- -		R	0.5	R	0.5
Hexachlorobenzene	µg/L	1	- -		- -		R	0.5	R	0.5
Hexachlorobutadiene	µg/L	0.14	- -		- -		R	1	R	1
Hexachlorocyclopentadiene	µg/L	50	- -		- -		R	16	R	15
Hexachloroethane	µg/L	0.33	- -		- -		R	5	R	5
Indeno (1,2,3-c,d) pyrene	µg/L	0.034	- -		- -		R	0.5	R	0.5
n-Nitrosodi-n-propylamine	µg/L	0.011	- -		- -		R	1	R	1
n-Nitrosodiphenylamine	µg/L	12	- -		- -		R	1	R	1
Nitrobenzene	µg/L	0.14	- -		- -		R	1	R	1
p-Cresol	µg/L	1900	- -		- -		1 U	1	1 U	1
Pentachlorophenol	µg/L	1	- -		- -		5 U	5	5 U	5
Phenanthrene	µg/L	NA	- -		- -		R	0.5	R	0.5
Phenol	µg/L	5800	- -		- -		1 U	1	1 U	1
Pyrene	µg/L	120	- -		- -		R	0.5	R	0.5

Table 6. Summary of Additional Analyses - Phase V

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results									
	Location>>		INS-0573		INS-0574		TW-105		TW-105		TW-106	
	Sample ID>>		0573-GW01-012116		0574-GW01-012116		TW105-GW-011416		TW105-GW-011416D		TW106-GW-011416	
	Depth (ft)>>		46-50		47-51		48-58		48-58		48-58	
	Sample Date>>		1/21/2016		1/21/2016		1/14/2016		1/14/2016		1/14/2016	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL		RL		RL
VOC												
1,1,2,2-Tetrachloroethane	µg/L	0.076	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,1,2-Trichloroethane	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2,4-Trimethylbenzene	µg/L	15	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,2-Dichloropropane	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,3,5-Trimethylbenzene	µg/L	120	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,3-Dichlorobenzene	µg/L	NA	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
1,4-Dichlorobenzene	µg/L	75	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
2-Butanone	µg/L	5600	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
2-Hexanone	µg/L	38	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
4-Methyl-2-pentanone	µg/L	6300	5 U	5	5 U	5	5 U	5	5 U	5	5 U	5
Bromodichloromethane	µg/L	80	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Bromomethane	µg/L	7.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Carbon disulfide	µg/L	810	1 U	1	1 U	1	1 U	1	1 U	1	1 U	1
Carbon tetrachloride	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Chloromethane	µg/L	190	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
cis-1,2-Dichloroethylene	µg/L	70	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Dibromochloromethane	µg/L	80	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Methylene chloride	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Styrene	µg/L	100	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trans-1,2-Dichloroethylene	µg/L	100	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Trichloroethylene	µg/L	5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Vinyl chloride	µg/L	2	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Xylenes, Total	µg/L	10000	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
SVOC												
2,4,5-Trichlorophenol	µg/L	1200	- -		1 U	1	- -		- -		- -	
2,4,6-Trichlorophenol	µg/L	4.1	- -		1 U	1	- -		- -		- -	
2,4-Dichlorophenol	µg/L	46	- -		1 U	1	- -		- -		- -	
2,4-Dimethylphenol	µg/L	360	- -		1 U	1	- -		- -		- -	
2,4-Dinitrophenol	µg/L	39	- -		30 UJ	30	- -		- -		- -	
2,4-Dinitrotoluene	µg/L	0.24	- -		5 U	5	- -		- -		- -	
2,6-Dinitrotoluene	µg/L	0.049	- -		1 U	1	- -		- -		- -	
2-Chloronaphthalene	µg/L	750	- -		1 U	1	- -		- -		- -	
2-Chlorophenol	µg/L	91	- -		1 U	1	- -		- -		- -	
2-Methylnaphthalene	µg/L	36	- -		0.5 U	0.5	- -		- -		- -	

Table 6. Summary of Additional Analyses - Phase V

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results									
	Location>>		INS-0573		INS-0574		TW-105		TW-105		TW-106	
	Sample ID>>		0573-GW01-012116		0574-GW01-012116		TW105-GW-011416		TW105-GW-011416D		TW106-GW-011416	
	Depth (ft)>>		46-50		47-51		48-58		48-58		48-58	
	Sample Date>>		1/21/2016		1/21/2016		1/14/2016		1/14/2016		1/14/2016	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL		RL		RL
SVOC (continued)												
2-Methylphenol	µg/L	930	- -		1 U	1	- -		- -		- -	
2-Nitroaniline	µg/L	190	- -		1 U	1	- -		- -		- -	
2-Nitrophenol	µg/L	NA	- -		1 U	1	- -		- -		- -	
3,3'-Dichlorobenzidine	µg/L	0.13	- -		5 U	5	- -		- -		- -	
3-Nitroaniline	µg/L	NA	- -		1 U	1	- -		- -		- -	
4,6-Dinitro-2-methylphenol	µg/L	1.5	- -		15 U	15	- -		- -		- -	
4-Bromophenyl phenyl ether	µg/L	NA	- -		1 U	1	- -		- -		- -	
4-Chloro-3-methylphenol	µg/L	1400	- -		1 U	1	- -		- -		- -	
4-Chloroaniline	µg/L	0.37	- -		4 U	4	- -		- -		- -	
4-Chlorophenyl phenyl ether	µg/L	NA	- -		1 U	1	- -		- -		- -	
4-Nitroaniline	µg/L	3.8	- -		1 U	1	- -		- -		- -	
4-Nitrophenol	µg/L	42	- -		30 U	30	- -		- -		- -	
Acenaphthene	µg/L	530	- -		0.5 U	0.5	- -		- -		- -	
Acenaphthylene	µg/L	NA	- -		0.5 U	0.5	- -		- -		- -	
Anthracene	µg/L	1800	- -		0.5 U	0.5	- -		- -		- -	
Benzo (a) anthracene	µg/L	0.012	- -		0.5 U	0.5	- -		- -		- -	
Benzo (a) pyrene	µg/L	0.2	- -		0.5 U	0.5	- -		- -		- -	
Benzo (b) fluoranthene	µg/L	0.034	- -		0.5 U	0.5	- -		- -		- -	
Benzo (g,h,i) perylene	µg/L	NA	- -		0.5 U	0.5	- -		- -		- -	
Benzo(k)fluoranthene	µg/L	0.34	- -		0.5 U	0.5	- -		- -		- -	
Bis (2-chloroethoxy) methane	µg/L	59	- -		1 U	1	- -		- -		- -	
Bis (2-chloroethyl) ether	µg/L	0.014	- -		0.051 U	0.051	- -		- -		- -	
Bis (2-chloroisopropyl) ether	µg/L	710	- -		1 U	1	- -		- -		- -	
Bis (2-ethylhexyl) phthalate	µg/L	6	- -		5 U	5	- -		- -		- -	
Butyl benzylphthalate	µg/L	16	- -		5 U	5	- -		- -		- -	
Chrysene	µg/L	3.4	- -		0.5 U	0.5	- -		- -		- -	
Di-n-butylphthalate	µg/L	900	- -		5 U	5	- -		- -		- -	
Di-n-octylphthalate	µg/L	200	- -		5 U	5	- -		- -		- -	
Dibenzo (a,h) anthracene	µg/L	0.0034	- -		0.5 U	0.5	- -		- -		- -	
Dibenzofuran	µg/L	7.9	- -		1 U	1	- -		- -		- -	
Diethyl phthalate	µg/L	15000	- -		5 U	5	- -		- -		- -	
Dimethyl phthalate	µg/L	NA	- -		5 U	5	- -		- -		- -	
Ethyl ether	µg/L	3900	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5	0.5 U	0.5
Fluoranthene	µg/L	800	- -		0.5 U	0.5	- -		- -		- -	

Table 6. Summary of Additional Analyses - Phase V

Institute Eastern Property Boundary Investigation - Phase II through Phase V

Union Carbide Corporation, Institute Facility, Institute, West Virginia

			Deep Interval Results									
	Location>>		INS-0573		INS-0574		TW-105		TW-105		TW-106	
	Sample ID>>		0573-GW01-012116		0574-GW01-012116		TW105-GW-011416		TW105-GW-011416D		TW106-GW-011416	
	Depth (ft)>>		46-50		47-51		48-58		48-58		48-58	
	Sample Date>>		1/21/2016		1/21/2016		1/14/2016		1/14/2016		1/14/2016	
Analyte[a]	**Units**	**MCL / RSL**		RL		RL		RL		RL		RL
SVOC (continued)												
Fluorene	µg/L	290	- -		0.5 U	0.5	- -		- -		- -	
Hexachlorobenzene	µg/L	1	- -		0.5 U	0.5	- -		- -		- -	
Hexachlorobutadiene	µg/L	0.14	- -		1 U	1	- -		- -		- -	
Hexachlorocyclopentadiene	µg/L	50	- -		15 U	15	- -		- -		- -	
Hexachloroethane	µg/L	0.33	- -		5 U	5	- -		- -		- -	
Indeno (1,2,3-c,d) pyrene	µg/L	0.034	- -		0.5 U	0.5	- -		- -		- -	
n-Nitrosodi-n-propylamine	µg/L	0.011	- -		1 U	1	- -		- -		- -	
n-Nitrosodiphenylamine	µg/L	12	- -		1 U	1	- -		- -		- -	
Nitrobenzene	µg/L	0.14	- -		1 U	1	- -		- -		- -	
p-Cresol	µg/L	1900	- -		1 U	1	- -		- -		- -	
Pentachlorophenol	µg/L	1	- -		5 U	5	- -		- -		- -	
Phenanthrene	µg/L	NA	- -		0.5 U	0.5	- -		- -		- -	
Phenol	µg/L	5800	- -		1 U	1	- -		- -		- -	
Pyrene	µg/L	120	- -		0.5 U	0.5	- -		- -		- -	

Notes:

Risk-based screening levels (RBSLs) included for comparison are:

The maximum contaminant level (MCL), where available, or the USEPA regional screening level (RSL; November 2015) for tap water; and

The USEPA vapor intrusion screening level (VISL; November 2015), based on a target carcinogenic risk = 1E-05 for the commercial/industrial receptor and 1E-06 for the residential receptor, a target non-cancer hazard index = 1, and an average, regional groundwater temperature = 19 degrees Celsius, is compared to

Bold results indicate detected concentrations.

No shallow interval concentration is greater than the commercial/industrial VISL.

Grey shaded results indicate concentration detected above the MCL/RSL.

Italicized results indicate concentration detected above the Residential VISL.

mg/L = milligrams per liter

µg/L = micrograms per liter

NA = Not applicable

U flag indicates the constituent was not detected above the reporting detection limit.

UJ flag indicates the analyte was below the reported sample quantitation limit. However, the reported value is approximate.

K flag indicates the analyte was positively identified, but the associated numerical value may be biased high.

R flag indicates the sample results are rejected due to serious deficiencies in the ability to analyze the sample and to meet the quality control criteria. The presence or absence of the analyte cannot be verified.

Table 7. Summary of Groundwater Level Survey

Institute Eastern Property Boundary Investigation - Phase II through Phase V
Union Carbide Corporation Institute Facility, Institute, West Virginia

Monitoring Well	Northing (ft)	Easting (ft)	TOC Elevation (ft amsl)	Depth to GW (ft btoc)	Depth to GW (ft bgs)	GW Elevation (ft amsl)
TW-103	504595.97	1748041.95	598.19	17.56	17.56	580.63
TW-104	504156.67	1747754.86	595.16	15.00	15.00	580.16
TW-105	503173.55	1748737.08	599.74	20.78	20.78	578.96
TW-106	503123.19	1748162.64	599.78	20.98	20.98	578.80
TW-107	502113.07	1748686.48	594.77	18.58	18.58	576.19
TW-108	503311.59	1747477.30	594.40	16.26	16.26	578.14
TW-109	502969.53	1747262.70	596.25	18.85	18.85	577.40
TW-110	502241.17	1747508.99	594.11	21.40	21.40	572.71
TW-111	502496.53	1747724.57	594.29	19.98	19.98	574.31
TW-112	501862.37	1748182.90	585.87	14.60	14.60	571.27
TW-113	501422.93	1748539.93	592.59	25.00	25.00	567.59
TW-61	503361.70	1746551.64	594.93	15.35	15.35	579.58
TW-62B	503411.90	1745897.25	592.13	11.54	11.54	580.59
TW-64	502878.97	1745737.40	592.82	13.19	13.19	579.63
TW-65B	503266.54	1747298.28	595.30	17.05	17.05	578.25
TW-71B	504029.10	1746573.28	597.14	16.29	16.29	580.85
VW-3B	502560.61	1746768.24	595.59	21.28	21.28	574.31
VW-4B	504475.81	1747140.32	596.61	16.03	16.03	580.58
VW-5B	504304.75	1746956.17	597.71	16.75	16.75	580.96
VW-9B	505281.36	1746695.76	600.96	19.50	17.93	581.46
VW-11B	505560.41	1746319.53	600.12	18.39	16.19	581.73

Notes:

ft bgs = feet below ground surface

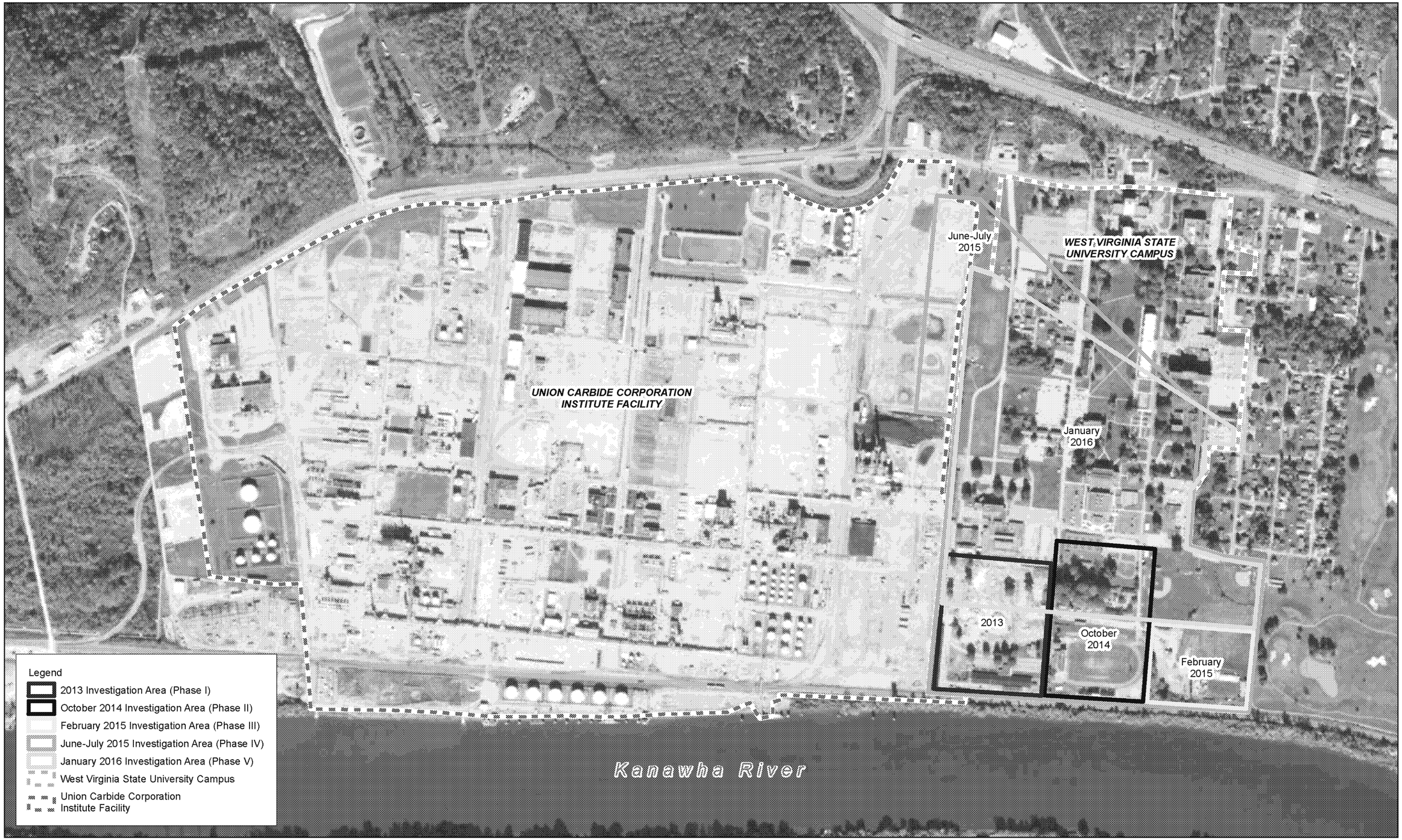
ft btoc = feet below top of casing

ft amsl = feet above mean sea level

GW = groundwater

TOC = top of casing

Figures



0 400 800
Feet

Note:
RCRA = Resource Conservation and Recovery Act

Figure 1
Site Map
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

ch2m:

MKE \\LAKEFRONT\PROJGIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG1_EASTPROP_INVESTIGATION.MXD AESPEJO 3/24/2016 2:36:11 PM

N

0 400 800

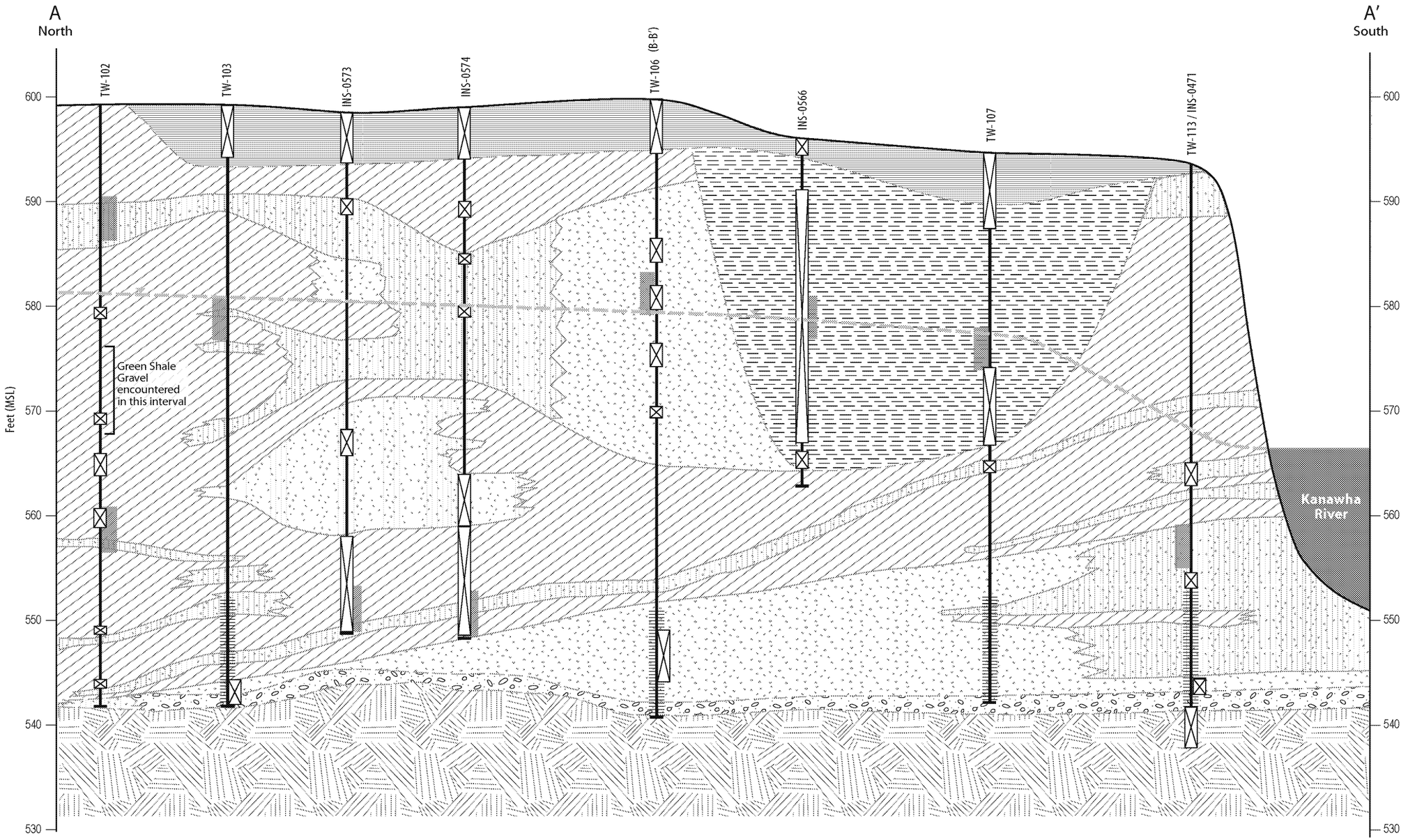
Feet

Note:
RCRA = Resource Conservation and Recovery Act
Wells TWs-02, 03, 04, 05, 06, 07, and 08 were sampled in the shallow and dep intervals during installation.

Figure 2
Sampling and Cross-Section Locations
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

ch2m

MKE \\LAKEFRONT\PROJ\GIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG2_SAMPLING_AND_CROSSSECTIONLOC.MXD AESPEJO 3/31/2016 5:19:21 PM



LEGEND

- Fill
- Flyash
- Clay, Silt, Silty Clay, Sandy Clay, or Sandy Silt
- Clayey or Silty Sand
- Sand
- Gravelly Sand
- Bedrock
- No Recovery Zone, or not sampled
- Groundwater Grab Sample
- Water Table
- Inferred Geologic Contact
- Well Screen Interval

10′
0′
500′

FIGURE 3A
Geological Cross Section A-A'
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

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ED_002092A_00000002-00060

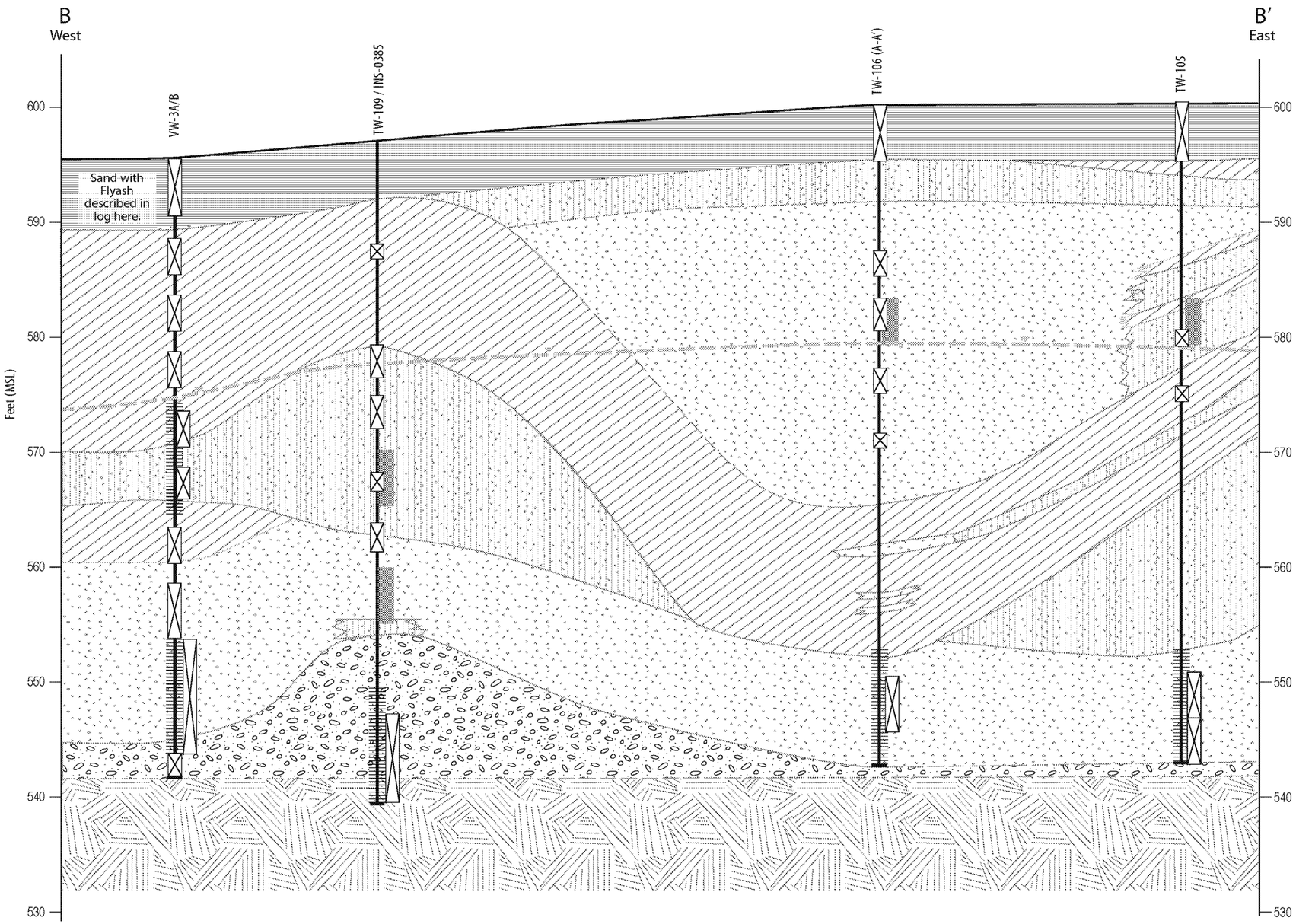

FIGURE 3B
Geological Cross Section B-B'
Eastern Property Boundary RCRA Corrective Action
Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

Legend

- Monitoring Well
- Soil Boring
- Facility Boundary
- West Virginia State University Campus
- Soild Waste Management Unit (SWMU)
- Area of Concern (AOC)

Silt/Clay Thickness

- < 1 ft
- 1 - 10 ft
- 10 - 20 ft
- 20 - 30 ft
- 30 - 40 ft
- 40 - 50 ft
- > 50 ft

0 450 900
Feet

Note:
* Indicates at least 20 feet of fly ash noted in boring impacting measured thickness. Locations were not contoured.
RCRA = Resource Conservation and Recovery Act

Figure 4
Silt/Clay Thickness
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

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MKE \\LAKEFRONT\PROJGIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG4_SILTCLAY_THICKNESS.MXD AESPEJO 3/30/2016 1:50:03 PM

Note:
* Indicates at least 20 feet of fly ash noted in boring potentially impacting measured thickness.
> Bedrock (refusal) was not identified in the boring. As permeable units lie on the bedrock surface, the estimated thickness is greater than the value shown.
RCRA = Resource Conservation and Recovery Act

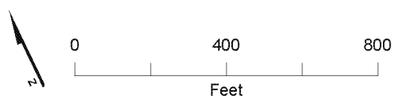
Figure 5
Saturated Permeable Aquifer Thickness
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

ch2m

MKE \\LAKEFRONT\PROJ\GIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG5_SATURATED_PERM_AQUIFER.MXD AESPEJO 3/30/2016 1:52:48 PM

Summary of Fill in Borings	
INS-0387	8 ft of fill in top of boring
INS-0388	fill from 10 to 11.5 ft bgs
INS-0469	~10 ft of fill, fly ash at 16.5 to 18 ft bgs
INS-0470	fly ash from 8 to 34.5 ft bgs
INS-0563	fly ash from 9 to 10 ft bgs (NR from 0 to 9 ft bgs)
INS-0566	fly ash from 1.5 to 5 ft bgs & 24 to 25 ft bgs; NR to 26.5 ft bgs
TW-107	fly ash fill estimated to 27.5 ft bgs (NR 0-6.5, 15-19, & 20-27.5 ft bgs)
TW-108	fill from 6 to 17 ft bgs

Notes:
ft - feet
bgs - below ground surface
EOB - end of boring
NR - no recovery

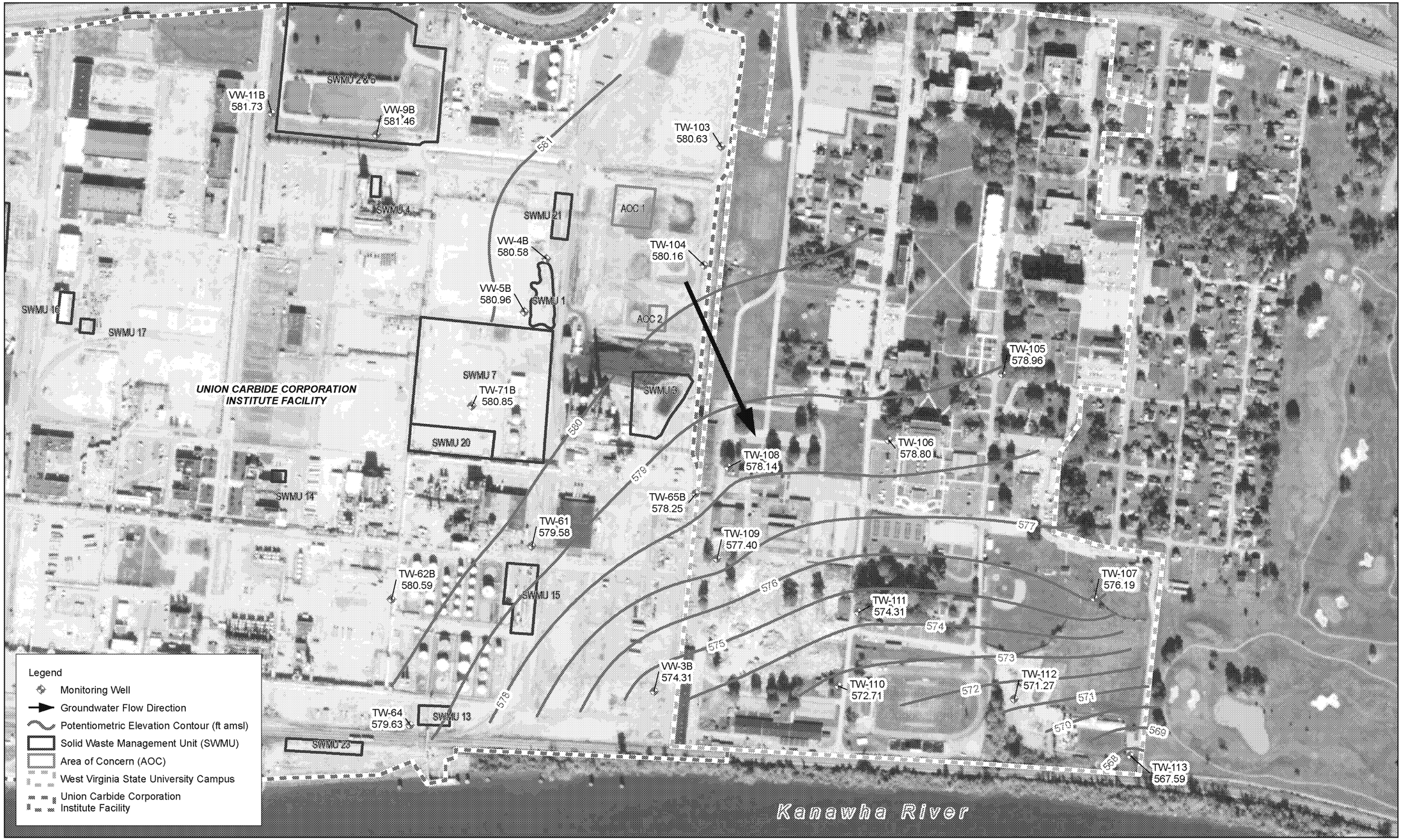


Notes:
Historic drainage features digitized from a 1955 aerial photograph and 1958 topographic map
RCRA = Resource Conservation and Recovery Act

Figure 6
Historical Surface Water Drainage Features and Impoundments
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

ch2m:

MKE \\LAKEFRONT\PROJ\GIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG6_HISTORICAL_SURFACE_WATER_DRAINAGE_FEATURES.MXD AESPEJO 4/6/2016 12:57:37 PM



Notes:
ft amsl = feet above mean sea level
RCRA = Resource Conservation and Recovery Act

Figure 7
Potentiometric Surface Map - August 7, 2015
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

ch2m:

MKE \\LAKEFRONT\PROJGIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIGURE 07 - EASTERN BNDRY POT MAP.MXD AESPEJO 3/22/2016 9:24:33 PM

ED_002092A_00000002-00070

N

0 400 800

Feet

Notes:
RSL = Regional Screening Level
*Data is from 2010 groundwater sampling.
RCRA = Resource Conservation and Recovery Act

Qualifiers:
J = Indicate the reported concentration is estimated.
L = The analyte was positively identified, but the associated numerical value may be biased low.
< = The constituent was not detected above the reporting detection limit.
UJ = Indicate the constituent was not detected above an estimated reporting detection limit.

Figure 8
Distribution of 1,4-Dioxane in Shallow Groundwater
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

ch2m

MKE \\LAKEFRONT\PROJ\GIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG8_1,4_DIOXANE.MXD AESPEJO 3/31/2016 11:02:37 AM

Notes:
RSL = Regional Screening Level
*Data is from 2014 groundwater sampling.
Blue font presents sample results from Phase V (January 2016).
RCRA = Resource Conservation and Recovery Act

Qualifiers:
< = The constituent was not detected above the reporting detection limit.

Figure 9
Distribution of 1,1-Dichloroethane in Deep Groundwater
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

ch2m:

MKE \\LAKEFRONT\PROJ\GIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG9_1,1_DICHLOROETHANE.MXD AESPEJO 3/30/2016 6:55:37 PM

N

0 400 800

Feet

Notes:
RSL = Regional Screening Level
*Data is from 2014 groundwater sampling.
**Data is from 2012 groundwater sampling.
***Data is from 2010 groundwater sampling.
Blue font presents sample results from Phase V (January 2016).
RCRA = Resource Conservation and Recovery Act

Qualifiers:
J = Indicate the reported concentration is estimated.
K = Indicate the reported concentration is biased high.
< = The constituent was not detected above the reporting detection limit.
UJ = Indicate the constituent was not detected above an estimated reporting detection limit.

Figure 10
Distribution of 1,4-Dioxane in Deep Groundwater
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

ch2m:

MKE \\LAKEFRONT\PROJGIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG10_1.4_DIOXANE.MXD AESPEJO 3/31/2016 5:46:40 PM

Notes:
1. * Petroleum Hydrocarbons relative percent at INS-0390 is 1.51.
2. 1,4-Dioxane detected at INS-0469, INS-0470 and INS-0471.
3. Chlorinated hydrocarbons include 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, chlorobenzene and tetrachloroethene.
4. Petroleum hydrocarbons include benzene, ethylbenzene, and toluene.
5. Fluorocarbon products include dichlorodifluoromethane and trichlorofluoromethane.
6. RCRA = Resource Conservation and Recovery Act
7. COPC = Constituent of Potential Concern

Figure 11
COPC Distribution in Shallow Groundwater
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

ch2m:

MKE \\LAKEFRONT\PROJ\GIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG11_COPC DISTRIBUTION IN SHALLOW GW.MXD AESPEJO 4/6/2016 9:28:53 PM

Notes:
1. * Petroleum Hydrocarbons relative percent at INS-0390 is 1.35.
2. ** Petroleum Hydrocarbons and 1,4-dioxane relative percents at INS-0388 are 1.78 and 1.84, respectively.
3. 1,4-Dioxane detected at INS-0470 and INS-0471.
4. Chlorinated hydrocarbons include 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, chlorobenzene and tetrachloroethene.
5. Petroleum hydrocarbons include benzene, ethylbenzene, and toluene.
6. Fluorocarbon products include dichlorodifluoromethane and trichlorofluoromethane.
7. (1) - Results reflect January 2016 confirmation sampling
8. RCRA = Resource Conservation and Recovery Act
9. COPC = Constituent of Potential Concern

Figure 12
COPC Distribution in Deep Groundwater
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

ch2m:

MKE \\LAKEFRONT\PROJ\GIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG12_COPC DISTRIBUTION IN DEEP GW.MXD AESPEJO 4/6/2016 9:21:46 PM

N

0 400 800

Feet

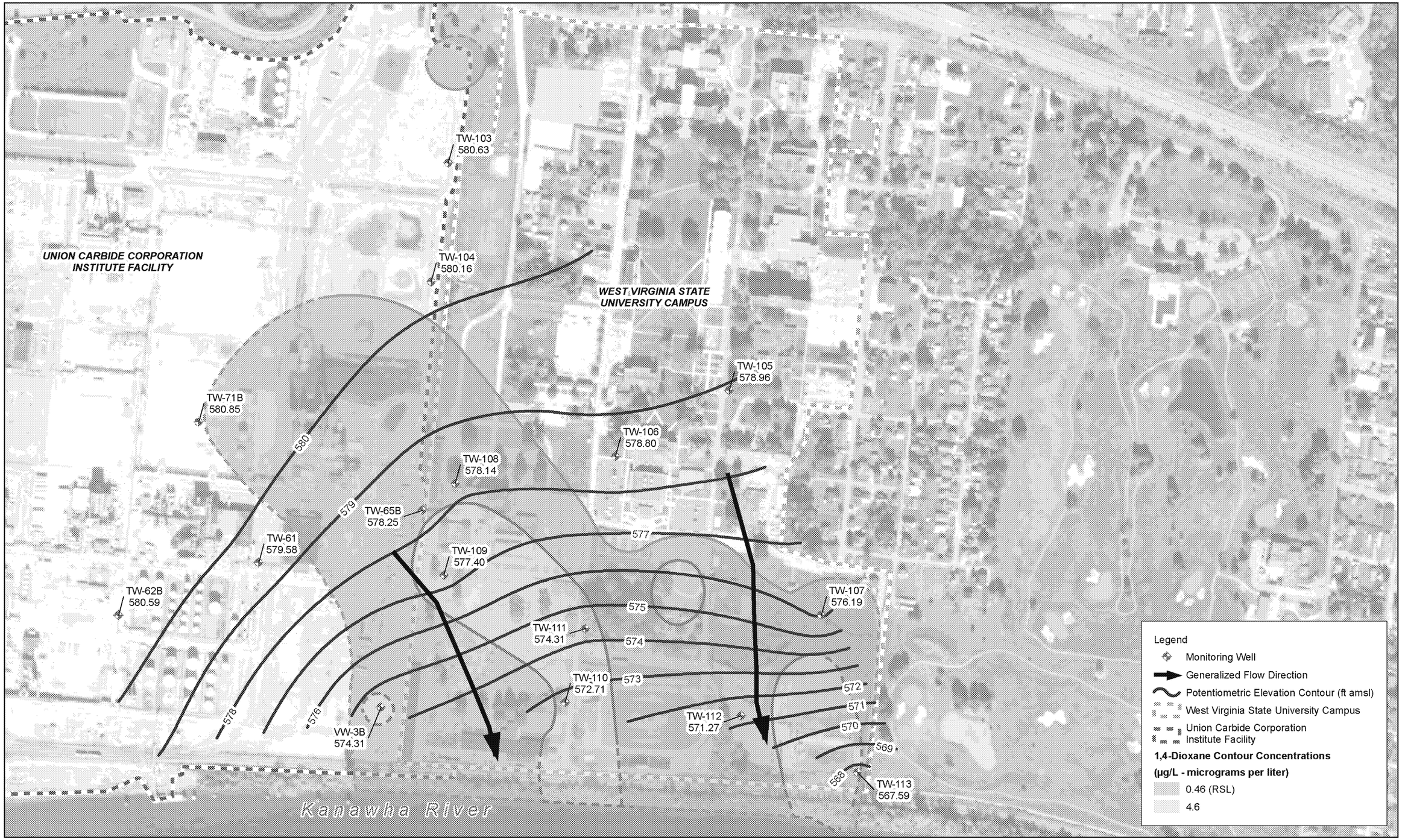
Notes:
MCL = U.S. Environmental Protection Agency maximum contaminant level.
*Data is from 2014 groundwater sampling.
Blue font presents sample results from Phase V (January 2016).
RCRA = Resource Conservation and Recovery Act

Qualifiers:
L = The analyte was positively identified, but the associated numerical value may be biased low.
< = The constituent was not detected above the reporting detection limit.

Figure 13
Distribution of Chloroform in Deep Groundwater
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

ch2m:

MKE \\LAKEFRONT\PROJ\GIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG13_CHLOROFORM.MXD AESPEJO 4/6/2016 11:49:38 AM



N

0 400 800

Feet

Notes:
RSL = Regional Screening Level
ft amsl = feet above mean sea level
Fill noted as containing various material including fly ash.
Estimate of fill extent in southwest portion of the campus based on historical drainage.
RCRA = Resource Conservation and Recovery Act

Figure 14
Conceptual Site Model (Shallow 1,4-Dioxane)
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

ch2m

MKE \\LAKEFRONT\PROJ\GIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG14_CONCEPTUAL_SITE_DIOX_SHALLOW.MXD AESPEJO 4/1/2016 2:45:04 PM

Notes:
RSL = Regional Screening Level
ft amsl = feet above mean sea level
Fill noted as containing various material including fly ash.
Estimate of fill extent in southwest portion of the campus based on historical drainage.
RCRA = Resource Conservation and Recovery Act

Figure 15
Conceptual Site Model (Deep 1,4 Dioxane)
Eastern Property Boundary RCRA Corrective Action Investigation – Phase II through V
Union Carbide Corporation Institute Facility
Institute, West Virginia

MKE \\LAKEFRONT\PROJGIS\DOW\INSTITUTE\REPORTS\2016\RCRA\MAPFILES\FIG15_CONCEPTUAL_SITE_DIOX_DEEP.MXD AESPEJO 4/1/2016 2:44:17 PM

Attachment 1
Boring Logs and Well Completion Diagrams

March 2013

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
435188	0385 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary — LOCATION : Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- — START : 3/15/13 09:45 — END : 3/15/13 11:25 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		0.0 / 5.0	MC1	**Fill** 0.0-5.0' - Hand auger o-1' - Asphalt and Sandy Gravel 1-5' - Clay, brown, dry to moist			
5	5.0						
		4.0 / 5.0	MC2	**Clay (CL)** 5.0-9.0' - brown, dry to moist, medium stiff, clay with little silt, micacious		0 0 0 0	
				9.0-10.0' - no recovery			
10	10.0						
		5.0 / 5.0	MC3	**Clayey Sandy Silt (ML)** 10.0-16.5' - brown, moist, medium stiff, silt with some clay and little sand		0 0 0 0 0 0	
15	15.0						
		3.0 / 5.0	MC4	**Sandy and Clay layering (SC)** 16.5-18.0' - brown, moist, stiff, medium dense, sand is fine grained, poorly graded		0 0	
				18.0-20.0' - no recovery			
20	20.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
435188	0385	SHEET 2 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary — LOCATION : Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- — START : 3/15/13 09:45 — END : 3/15/13 11:25 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0			**Silty Sand (SM)** 20.0-22.0' - brown, wet, loose, fine grained, poorly sorted		0 0	
		2.0 5.0	MC5	22.0-25.0' - no recovery			
25	25.0			**Silty Sand (SM)** 25.0-27.0' - brown, wet, medium dense, sand with little silt, medium grained, poorly sorted		0 0	
		4.0 5.0	MC6	**large Sandstone rocks and Sand (SW)** 27.0-27.5' - brown, wet, medium dense, well graded, sand and gravel, medium grained sand, gravel .10-.15' **Silty Sand (SM)** 27.5-29.0' - brown, wet, medium dense to loose, sand with little silt 29.0-30.0' - no recovery		0 0	
30	30.0			**Silty Sand (SM)** 30.0-33.5' - brown, wet, medium dense, sand with trace silt		0 0 0	
		3.5 5.0	MC7	33.5-35.0' - no recovery			
35	35.0			**Sand (SP)** 35.0-39.0' - tan and brown, wet, loose, medium grained to coarse grained at 36-36.5', poorly graded		0 0 0 0	
		5.0 5.0	MC8	**Sand (SP)** 39.0-40.0' - gray, wet, loose, organic material - wood found at 39.8', poorly graded		0	
40	40.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
435188	0385 SHEET 3 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary — LOCATION : Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- — START : 3/15/13 09:45 — END : 3/15/13 11:25 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	40.0			**Sand (SW)** 40.0-41.5' - tan, wet, loose, medium and coarse grained, well graded		0	
		5.0 5.0	MC9	**Silty Sand (SM)** 41.5-42.5' - brown, wet, loose, fine grained, poorly graded, sand with trace silt		0	
				Silty Sand (SM) 42.5-43.0' - gray, wet, loose, fine grained, poorly graded, sand with little silt, organic material - wood at 42.7'		0	
45	45.0			**Gravelly Sand (SW)** 43.0-45.0' - brown, wet, loose, medium and coarse grained, well graded, sand with little gravel, gravel is well rounded sandstone		0	
		6.0 6.0	MC10	**Gravelly Sand (SW)** 45.0-51.0' - gray, wet, loose, medium and fine grained, well graded, sand with little gravel, gravel is semi rounded and some are angular		0	
50	51.0					0	
				Bottom of Boring at 51.0 ft below ground surface			Refusal at 51.0 ft
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
435188	0387 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- START : 3/13/13 14:15 END : 3/15/13 16:30 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		0.0 5.0	MC1	**Fill** 0.0-5.0' - Air knife 0-4' - Silty Clay, dry to moist, brown 4-5' - Silty material, gray, white and black specs, no odor			
5	5.0						
		5.0 5.0	MC2	**Fill** 5.0-8.0' - gray and black material, silty, white specs, wet, soft, wet looks metallic, no odor		0.2 0.3 0.3	Collected Soil Sample: 0387-SO01-031313 at 5.5-6.0' for VOCs and SVOCs
				Gravelly Clay (CL) 8.0-13.5' - light brown and gray mottled, moist to dry, soft, clay with little gravel		0.3 0.1 0.4 0.1 0	
10	10.0						
		3.5 5.0	MC3	13.5-15.0' - no recovery			
15	15.0			**Clay (CL)** 15.0-17.5' - light brown and gray mottled, dry, stiff to very stiff		0.4 0	
		2.5 5.0	MC4	17.5-20.0' - no recovery		0	
20	20.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
435188	0387	SHEET 2 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary — LOCATION : Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- — START : 3/13/13 14:15 — END : 3/15/13 16:30 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0			**Sandy Clay (CL)** 20.0-20.5' - brown, moist, soft, clay with some sand		0.2	
				Silty Sandy Clay (CL) 20.5-22.0' - brown, moist, soft, clay with some silt and little fin grained sand		0.3	
		4.5 5.0	MC5	**Silty Clay (CL)** 22.0-24.0' - brown, moist, medium stiff, clay with little silt, micaceous		0 0	
				Silty Sandy Clay (CL) 24.0-24.5' - brown, moist, soft, clay with some silt and little fine grained sand			
25	25.0			24.5-25.0' - no recovery			
				Silty Sand (SM) 25.0-25.5' - dark brown, wet, loose, sand with some silt, fine to medium grained, poorly graded		0.2	
				Silty Clay (CL) 25.5-27.5' - brown, moist, medium stiff, clay with little silt		0.2	
		4.5 5.0	MC6	**Clayey Sand (SC)** 27.5-29.5' - brown, moist to wet, medium dense, sand with little clay, fine grained, poorly graded		0.1 0	
30	30.0			29.5-30.0' - no recovery			
				Clayey Sand (SC) 30.0-31.0' - brown, wet, medium dense, sand with little clay, fine grained, poorly graded		0	
				Silty Sand (SM) 31.0-33.0' - gray, wet, loose, sand with some silt, fine grained, poorly graded		0.2 0	
		4.0 5.0	MC7	**Silty Sand (SM)** 33.0-34.0' - brownish orange, wet, loose, sand with some silt, medium grained, poorly graded		0	
35	35.0			34.0-35.0' - no recovery			
				Silty Sand (SM) 35.0-39.5' - brownish orange, wet, loose, sand with little silt, medium grained, poorly graded		0.1 0 0 0	
		4.5 5.0	MC8				
40	40.0			39.5-40.0' - no recovery			

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
435188	0387 SHEET 3 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- START : 3/13/13 14:15 END : 3/15/13 16:30 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	40.0	4.5 / 5.0	MC9	**Silty Sand (SM)** 40.0-44.5' - brownish orange, wet, loose, sand with little silt, medium grained		0.1 0.1 0.1 0.1	
45	45.0			44.5-45.0' - no recovery			
		6.0 / 7.0	MC10	**Sand (SP)** 45.0-49.0' - brown, wet, loose, poorly graded, medium grained		0.1 0.2 0.1	
50				49.0-52.0' - no recovery			
	52.0			Bottom of Boring at 52.0 ft below ground surface			Refusal at 52.0 ft
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
435188	0388 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- START : 3/14/13 11:30 END : 3/14/13 13:30 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		0.0 5.0	MC1	**Silty Clay (CL)** 0.0-5.0' - black and brown, moist to dry, Air knife			
5	5.0						
		4.0 5.0	MC2	**Gravelly Silty Clay (CL)** 5.0-6.0' - brown, dry, stiff, clay with some gravel and some silt		0	
				Fill 6.0-9.0' - silty fine grained non native material, includes white specs and some black specs in layers, wet		0.1 0.1 0.2	
				9.0-10.0' - no recovery		0.1	
10	10.0						
		5.0 5.0	MC3	**Fill** 10.0-11.5' - silty fine grained non native material, includes white specs and some black specs in layers, wet		0	
				Silty Gravelly Clay (CL) 11.5-15.0' - brown and gray mottled, dry to moist, stiff, clay with little silt and trace (small) gravel		0.1 0 0 0	
15	15.0						
		2.5 5.0	MC4	**Silty Clay (CL)** 15.0-17.5' - brown, dry, very stiff, clay with trace silt		0 0	
				17.5-20.0' - no recovery			
20	20.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
435188	0388 SHEET 2 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- START : 3/14/13 11:30 END : 3/14/13 13:30 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0			**Clayey Silt (ML)** 20.0-21.5' - brown, dry to moist, stiff, silt with some clay		0	
				Sandy Silt (ML) 21.5-25.5' - brown, moist, soft to medium stiff, silt with little fine grained sand		0	
		3.5 5.0	MC5			0	
						0	
25	25.0						
				Clayey Sand (SC) 25.5-27.0' - brown, wet, loose, sand with some clay, fine grained, poorly graded		0	
						0	
				Silty Sand (SM) 27.0-29.0' - brown, wet, medium dense, sand and silt, fine grained, poorly graded		0	
		4.0 5.0	MC6			0	
				29.0-30.0' - no recovery			
30	30.0					0	
				Sandy Clay (CL) 30.0-32.5' - brown to brownish gray toward 32', wet, medium stiff, clay with little fine grained sand		0	
						0	
						0	
		4.5 5.0	MC7	**Clayey Sand (SC)** 32.5-34.0' - brown and gray, wet, medium dense to loose, sand with some clay, fine grained, poorly graded		0	
						0	
				Silty Sand (SM) 34.0-34.5' - brown and orange layers, wet, medium dense, sand with little silt, medium grained, poorly graded			
35	35.0						
				34.5-35.0' - no recovery		0	
				Silty Sand (SM) 35.0-52.0' - brown, wet, medium dense, sand with little silt, medium grained, poorly graded, sandstone at 36.5' and 38.0'		0	
		3.0 5.0	MC8			0	
						0	
40	40.0					0	

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
435188	0388 SHEET 3 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- START : 3/14/13 11:30 END : 3/14/13 13:30 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	40.0						
		5.0 / 5.0	MC9				
45	45.0						
		5.0 / 7.0	MC10				
50							
	52.0						
				Bottom of Boring at 52.0 ft below ground surface			Refusal at 52.0 ft
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
435188	0389 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- START : 3/12/13 10:20 END : 3/12/13 12:25 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		0.0 / 5.0	MC1	**Clayey Silt (ML)** 0.0-5.0' - brown, moist, Air knife			
5	5.0						
		5.0 / 5.0	MC2	**Silty Clay (CL)** 5.0-7.0' - brown and gray mottled, moist, medium stiff, clay with little silt		0 0	
				Silty Clay (CL) 7.0-10.0' - brown, moist, medium stiff to stiff, clay with trace silt		0 0 0	
10	10.0						
		5.0 / 5.0	MC3	**Silty Clay (CL)** 10.0-15.0' - brown, moist, stiff, clay with trace silt		0 0 0 0 0	
15	15.0						
		5.0 / 5.0	MC4	**Silty Clay (CL)** 15.0-20.0' - brown, moist to wet, medium stiff, clay with trace silt, micaceous		0 0 0 0 0	
20	20.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
435188	0389	SHEET 2 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary — LOCATION : Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- — START : 3/12/13 10:20 — END : 3/12/13 12:25 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0			**Clay (CL)** 20.0-21.5' - brown, moist to wet, soft		0	
		4.0 5.0	MC5	**Silty Clay (CL)** 21.5-24.0' - brown, moist to wet, medium stiff, clay with little silt		0 0 0	
				24.0-25.0' - no recovery			
25	25.0						
		4.0 5.0	MC6	**Silty Clay (CL)** 25.0-26.5' - brown, moist to wet, soft, clay with some silt		0	
				Clayey Sand (SC) 26.5-28.0' - brown, moist, medium dense, sand and clay, fine grained, poorly graded		0 0	
				Silty Sand (SM) 28.0-29.0' - brownish orange, moist, dense, sand with some silt, fine grained, poorly graded		0	
				29.0-30.0' - no recovery			
30	30.0						
		5.0 5.0	MC7	**Silty Sand (SM)** 30.0-31.5' - brown, wet, loose, sand with some silt, fine grained, poorly graded		0	water at 30'
				Clayey Sand (SC) 31.5-35.0' - gray, moist, medium dense, sand with some clay, fine grained, poorly graded		0 0 0 0	
35	35.0						
		5.0 5.0	MC8	**Organic wood** 35.0-36.5'		0	
				Sandy Clay (CL) 36.5-37.5' - gray, wet, soft, clay with some sand		0	
				Silty Sand (SM) 37.5-40.5' - brownish orange, wet, loose, sand with little silt, well graded, fine to medium grained with depth		0 0 0	
40	40.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
435188	0389	SHEET 3 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary — LOCATION : Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- — START : 3/12/13 10:20 — END : 3/12/13 12:25 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	40.0						
		3.0 / 5.0	MC9	**Sand (SP)** 40.5-41.7' - light gray, wet, loose, medium grained, poorly graded		0	
				Sand (SP) 41.7-43.0' - dark orange, wet, medium dense, fine grained, poorly graded		0	
				43.0-45.0' - no recovery		0	
45	45.0						
		3.5 / 5.0	MC10	**Sand (SP)** 45.0-47.5' - brown, wet, medium dense, medium grained, poorly graded		0	
						0	
				Sand (SW) 47.5-48.5' - black, gray, light gray, wet, medium dense, fine to medium grained, well graded		0	
				48.5-50.0' - no recovery			Bedrock at 49.0'
50	50.0						
				Bottom of Boring at 50.0 ft below ground surface			
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
435188	0390 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- START : 3/12/13 14:10 END : 3/12/13 15:45 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		0.0 / 5.0	MC1	**Clayey Silt (ML)** 0.0-5.0' - brown, dry to moist, Air knife			
5	5.0						
		5.0 / 5.0	MC2	**Silty Clay (CL)** 5.0-6.5' - brown and gray mottled, dry to moist, stiff, clay with trace silt, some small black gravel from 5-6'		0	
				Silty Clay (CL) 6.5-14.5' - brown, dry to moist, very stiff, clay with trace silt, micaceous		0	
						0	
						0	
10	10.0					0	
		4.5 / 5.0	MC3			0	
						0	
						0	
						0	
						0	
15	15.0			14.5-15.0' - no recovery			
		5.0 / 5.0	MC4	**Silty Clay (CL)** 15.0-21.0' - brown, dry to moist, very stiff, clay with trace silt, micaceous		0	
						0	
						0	
						0	
						0	
20	20.0					0	

CH2MHILL

PROJECT NUMBER: 435188	BORING NUMBER: 0390 SHEET 2 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary — LOCATION : Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- — START : 3/12/13 14:10 — END : 3/12/13 15:45 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0					0	
				Silty Clay (CL) 21.0-22.0' - brown, moist, stiff, clay with little silt		0	
		5.0 5.0	MC5	**Silty Clay (CL)** 22.0-25.0' - brown, moist, soft, clay with little silt		0	
						0	
25	25.0					0	
				Silty Clay (CL) 25.0-26.0' - brown, moist, stiff, clay with little silt		0	
				Silty Sand (SM) 26.0-27.5' - brown, moist, loose, sand with some silt, very fine grained, poorly graded		0	
		2.5 5.0	MC6	27.5-30.0' - no recovery			
30	30.0						
				Silty Clayey Sand (SM & SC) 30.0-33.0' - brown, gray, orange mottled, moist, medium dense to loose, sand with some silt and some clay, fine grained sand, well graded, wet at 30.5'		0	
						0	
		5.0 5.0	MC7			0	
				Silty Sand (SM) 33.0-35.0' - brown, wet, medium dense, sand with little silt, fine to medium grained, well graded		0	
35	35.0					0	
				Silty Sand (SM) 35.0-36.5' - brown and gray, wet, loose, sand with some silt, fine grained, poorly graded		0	
				Silty Sand (SM) 36.5-40.0' - black, gray, brown, wet, loose, sand with little silt, fine to medium grained gradation to depth, well graded, small coal layer at 36.0'		0	
		4.0 5.0	MC8			0	
						0	
40	40.0					0	

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
435188	0390 SHEET 3 OF 3

SOIL BORING LOG

PROJECT : East Property Boundary LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT Powerprobe 9500 VTR

WATER LEVELS : --- START : 3/12/13 14:10 END : 3/12/13 15:45 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	40.0			**Silty Sand (SM)** 40.0-45.0' - black, brown, orange, wet, loose to medium dense, sand with little silt, well graded, fine to medium grained sand		0	
		5.0 5.0	MC9			0	
						0	
						0	
45	45.0					0	
				Sand (SP) 45.0-47.5' - brown to gray, wet, medium dense, medium grained, poorly graded		0	
						0	
		2.5 5.0	MC10	47.5-50.0' - no recovery			Bedrock at 47.5 ft
50	50.0						
				Bottom of Boring at 50.0 ft below ground surface			
55							
60							

October 2014

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0465 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation
LOCATION : WVSU, Institute, WV
ELEVATION :
DRILLING CONTRACTOR : Subsurface Inc.
DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR
WATER LEVELS : ---
START : 10/27/14 10:10
END : 10/27/14 13:09
LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
				Fill 0.0-0.2' - grass, roots		0	PID background = 0
				Gravelly Clayey Silt (ML) 0.2-1.0' - brown, dry, medium stiff, silt with some clay and little gravel		0	
				Sandstone Cobble 1.0-1.5' - tan, dry, medium hard, broken rock		0	
		4.5 5.0	MC1	**Clayey Silt (ML)** 1.5-4.5' - brown, dry to moist, stiff, silt with trace clay		0	0-5 ft Breathing Zone = 0
5	5.0			4.5-5.0' - no recovery			
				Clayey Silt (ML) 5.0-14.0' - brown, dry to moist, very stiff, silt with trace clay, roots throughout		0	
						0	
		5.0 5.0	MC2			0	5-10 ft Breathing Zone = 0
						0	
						0	
10	10.0					0	
						0	
						0	
		5.0 5.0	MC3			0	
						0	10-15 ft Breathing Zone = 0
						0	
15	15.0			**Clayey Silt (ML)** 14.0-15.5' - brown, moist to dry, medium stiff, silty sand lenses (SM), loose sand, very fine grained sand, silt with trace clay		0	
				Silty Clay (CL) 15.5-17.0' - brown, moist, medium stiff to soft, clay with little silt		0	
						0	
		3.5 5.0	MC4	**Sandy Silt (ML)** 17.0-18.5' - brown, moist, stiff, with silty sand lenses (SM), silt with some very fine grained sand, sand with little silt		0	15-20 ft Breathing Zone = 0
				18.5-20.0' - no recovery			
20	20.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0465 SHEET 2 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation — LOCATION : WVSU, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- — START : 10/27/14 10:10 — END : 10/27/14 13:09 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0			**Sandy Silt (ML)** 20.0-21.0' - brown, moist, stiff, with silty sand lenses (SM), silt with some very fine grained sand, sand with little silt		0	
				Clayey Sand (SC) 21.0-22.5' - brown and tan, wet, loose, fine to medium grained sand with clay lenses, well graded from fine to medium grained		0	
		5.0 5.0	MC5	**Silty Sand (SM)** 22.5-26.5' - brown, wet, medium dense, medium grained sand with trace silt		0	20-25 ft Breathing Zone = 0 Sample collected: GW01-0465-102414 from 23-27 ft bgs
25	25.0					0	
						0	
				Gravelly Sand (SP) 26.5-27.5' - brown, wet, medium dense, medium grained sand with some sandstone gravel		0	25-30 ft Breathing Zone = 0
		3.0 5.0	MC6	**Silty Clay (CL)** 27.5-28.0' - gray, wet, soft, clay with trace silt		0	
				28.0-30.0' - no recovery			
30	30.0						
				Clayey Sand (SC) 30.0-30.5' - brown and gray, wet, loose, medium grained sand with some clay, sandstone cobble at 30.5'		0	
				Silty Sand (SM) 30.5-32.0' - orangish brown, wet, very loose, very fine grained, sand with some silt		0	
		3.0 5.0	MC7	**Clayey Sand (SC)** 32.0-32.5' - orange, wet, medium dense, fine to medium grained, sand with some clay lenses		0	30-35 ft Breathing Zone = 0
				Silty Clay (CL) 32.5-32.8' - gray, wet, soft, clay with trace silt			
				Silty Sand (SM) 32.8-33.0' - gray, wet, medium dense, medium grained, sand with trace silt			
35	35.0			33.0-35.0' - no recovery			
				Silty Sand (SM) 35.0-35.5' - gray, wet, loose, medium grained sand with some silt		0	
				Silty Clay (CL) 35.5-36.5' - gray, wet, soft, clay with little silt		0	35-40 ft Breathing Zone = 0
		3.0 5.0	MC8	**Clayey Sand (SC)** 36.5-37.2' - gray, moist to wet, medium dense, very fine grained sand with some clay, organic layers of wood throughout		0	
				Silty Sand (SM) 37.2-38.0' - gray, wet, medium dense, sand with trace silt, medium grained			
40	40.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0465 SHEET 3 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation LOCATION : WVSU, Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- START : 10/27/14 10:10 END : 10/27/14 13:09 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	40.0			38.0-40.0' - no recovery			
				Silty Sand (SM) 40.0-41.0' - gray, wet, medium dense, sand with trace silt, medium grained		0	
				Silty Clay (CL) 41.0-43.5' - gray, wet, soft, clay with some silt		0	
		4.5/5.0	MC9			0	40-45 ft Breathing Zone = 0 Sample collected GW02-0465-102714 from 44-47 ft bgs
				Silty Sand (SM) 43.5-44.5' - gray, wet, dense, medium grained, sand with trace silt		0	
45	45.0			44.5-45.0' - no recovery			
				Silty Sand (SM) 45.0-50.0' - gray, wet, medium dense, medium grained, sand with little silt		0	
						0	
		5.0/5.0	MC10			0	45-50 ft Breathing Zone = 0
50	50.0						
				Silty Sand (SM) 50.0-52.0' - gray, wet, medium dense, medium grained, sand with little silt Quartzite at 52.0 ft		0	
		2.0/2.0	MC11				50-52 ft Breathing Zone = 0
	52.0					0	
				Bottom of Boring at 52.0 ft below ground surface			Refusal at 52.0 ft
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0466 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation — LOCATION : WVSU, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- — START : 10/28/14 09:15 — END : 10/28/14 12:20 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
				Fill 0.0-0.1' - grass, roots			PID background = 0
		0.0 5.0	Airknife1	**Clayey Silt (ML)** 0.1-5.0' - brown, moist, (airknifed)			0-5 ft Breathing Zone = 0
5	5.0						
		4.0 5.0	MC2	**Clayey Silt (ML)** 5.0-9.0' - brown, dry to moist, medium stiff, silt with trace clay, sandstone rock at 7.0' bgs		0 0 0 0	5-10 ft Breathing Zone = 0
				9.0-10.0' - no recovery			
10	10.0						
		5.0 5.0	MC3	**Sandy Silt (ML)** 10.0-19.5' - brown, moist, medium stiff, silt with little very fine grained sand		0 0 0 0	10-15 ft Breathing Zone = 0
15	15.0					0	
		5.0 5.0	MC4			0 0 0 0 0	15-20 ft Breathing Zone = 0
20	20.0					0	

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0466 SHEET 2 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation
LOCATION : WVSU, Institute, WV
ELEVATION :
DRILLING CONTRACTOR : Subsurface Inc.
DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR
WATER LEVELS : ---
START : 10/28/14 09:15
END : 10/28/14 12:20
LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0			**Silty Sand (SM)** 19.5-20.0' - brown, moist, dense, very fine grained sand and silt		0	
				Silty Sand (SM) 20.0-25.5' - brown, wet, medium dense to loose, fine grained, poorly graded, sand with some silt		0	
		5.0 5.0	MC5			0	
						0	Sample collected GW01-0466-102414 from 22-26 ft bgs 20-25 ft Breathing Zone = 0
25	25.0					0	
				Gravelly Sand (SP) 25.5-27.0' - orange/brown/black, wet, dense, medium grained sand with some sandstone gravel, cobbles		0	
						0	
		3.2 5.0	MC6	**Sandy Clay (CL)** 27.0-28.2' - orange then gray at 27.5', wet, medium stiff, clay with some silt and sand lenses throughout		0	25-30 ft Breathing Zone = 0
				28.2-30.0' - no recovery			
30	30.0						
				Silty Sand (SM) 30.0-31.0' - gray, wet, loose, fine grained sand with some silt		0	
				Sandy Clay (CL) 31.0-31.5' - gray, wet, medium stiff, clay with fine grained sand lenses		0	
		4.0 5.0	MC7	**Silty Sand (SM)** 31.5-32.0' - gray then brown at 31.8', wet, medium dense, fine grained sand with some silt		0	
				Silty Clay (CL) 32.0-33.0' - gray, moist, medium stiff to soft, clay with little silt		0	30-35 ft Breathing Zone = 0
35	35.0			**Silty Sand (SM)** 33.0-34.0' - gray to brown, medium dense, medium grained sand with some silt			
				34.0-35.0' - no recovery			
				Silty Sand (SM) 35.0-38.0' - brown, wet, loose, medium grained sand with some silt		0	
						0	
		3.0 5.0	MC8			0	35-40 ft Breathing Zone = 0
				38.0-40.0' - no recovery			
40	40.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
650363	0466	SHEET 3 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation — LOCATION : WVSU, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- — START : 10/28/14 09:15 — END : 10/28/14 12:20 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	40.0			**Clayey Sand (SC)** 40.0-41.0' - gray, wet, loose, fine grained sand with some clay		0	
				Silty Sand (SM) 41.0-43.5' - gray, wet, medium dense, medium grained sand with little silt, sandstone at 42.5-43'		0	
		3.5 5.0	MC9			0	Sample collected GW02-0466-102814 from 42-46 ft bgs 40-45 ft Breathing Zone = 0
				43.5-45.0' - no recovery			
45	45.0						
				Silty Sand (SM) 45.0-47.5' - gray, wet, medium dense to loose, medium grained sand with little silt		0	
		4.0 4.0	MC10			0	45-49 ft Breathing Zone = 0
				Gravelly Sand (SP) 47.5-49.0' - gray, brown, wet, medium dense, medium grained sand with gravel, sandstone cobbles		0	
	49.0					0	
				Bottom of Boring at 49.0 ft below ground surface			Refusal at 49.0 ft
50							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0467 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation LOCATION : WVSU, Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- START : 10/21/14 10:02 END : 10/21/14 12:15 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		0.0 5.0	Airknife1	**Fill** 0.0-5.0' - grass roots (airknifed)			PID background = 0 0-5 ft Breathing Zone = 0
5	5.0						
		5.0 5.0	MC2	**Silty Clay (CL)** 5.0-15.0' - brown, moist, stiff, low plasticity, clay with little silt		0 0 0 0 0	
10	10.0						
		5.0 5.0	MC3			0 0 0 0 0 0	
15	15.0						
		5.0 5.0	MC4	**Silty Clay (CL)** 15.0-20.0' - brown, moist, soft to medium stiff, low to medium plasticity, clay with little silt		0 0 0 0 0	
20	20.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0467 SHEET 2 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation
LOCATION : WVSU, Institute, WV
ELEVATION :
DRILLING CONTRACTOR : Subsurface Inc.
DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR
WATER LEVELS : ---
START : 10/21/14 10:02
END : 10/21/14 12:15
LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0			**Silty Clay (CL)** 20.0-23.5' - brown, moist, soft, medium plasticity, clay and silt		0	
		5.0 5.0	MC5			0	
						0	
				Sandy Clay (CL) 23.5-26.0' - brown, moist, soft, clay with interbedded very fine grained sand		0	
25	25.0					0	
						0	
				Sandy Clay (CL) 26.0-29.5' - brown, moist, very soft, wet from 26.5-27.5', clay with interbedded sand, very fine grained		0	
		5.0 5.0	MC6			0	
						0	
						0	
30	30.0			**Silty Sand (SM)** 29.5-31.5' - brown, wet, loose, sand and silt, very fine grained, poorly graded		0	
						0	
				Sandy Clay (CL) 31.5-32.0' - brown, wet, soft, clay with some interbedded fine grained sand		0	Sample collected GW01-0467-102014 from 32-36 ft bgs
		5.0 5.0	MC7	**Sandy Clay (CL)** 32.0-34.0' - gray, wet, soft, clay and interbedded fine grained sand		0	
						0	
				Silty Sand (SM) 34.0-35.0' - brown/gray/orange layering, wet, fine to medium grained sand with little silt, well graded, fine to medium grained few sandstone pieces		0	
35	35.0						
				Silty Sand (SM) 35.0-37.5' - brown, wet, fine to medium grained sand with little silt, poorly graded		0	
						0	
		5.0 5.0	MC8			0	
				Sand and Sandstone rocks 37.5-38.0' - brown, wet, medium dense, medium grained, poorly graded		0	
				Silty Clay (CL) 38.0-38.2' - brown, wet, medium stiff, clay with little silt		0	
40	40.0					0	

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0467 SHEET 3 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation LOCATION : WVSU, Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- START : 10/21/14 10:02 END : 10/21/14 12:15 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	40.0			**Silty Sand (SM)** 38.2-41.2' - dark brown to brown, wet, medium dense to dense, sand with little silt, poorly graded, fine grained, color and density change at 39.5'		0	
		5.0 5.0	MC9	**Silty Gravelly Sand (SM-SP)** 41.2-44.5' - brown, wet, medium dense, medium grained sand with some silt and little gravel		0 0 0	Sample collected GW02-0467-102014 from 42-46 ft bgs
45	45.0			**Sand (SP)** 44.5-48.5' - gray, wet, medium dense, poorly graded, medium grained sand, dark gray sandstone pieces at 48.5' in drill shoe		0	
		3.5 3.5	MC10			0 0 0	
	48.5			Bottom of Boring at 48.5 ft below ground surface			Refusal at 48.5 ft
50							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0468 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation LOCATION : WVSU, Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- START : 10/24/14 10:10 END : 10/24/14 13:10 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		0.0 / 5.0	Airknife1	**Asphalt** 0.0-0.5' - 0-5' airknifed **Clayey Silt (ML)** 0.5-5.0' - dark brown, moist to dry			PID background = 0 0-5 ft Breathing Zone = 0
5	5.0						
		5.0 / 5.0	MC2	**Clayey Silt (ML)** 5.0-7.5' - dark brown, moist, medium stiff to soft, silty with some clay **Silty Clay (CL)** 7.5-22.0' - brown, moist, stiff, clay with little silt (20-22' soft)		0 0 0 0 0	5-10 ft Breathing Zone = 0
10	10.0						
		5.0 / 5.0	MC3			0 0 0 0 0	10-15 ft Breathing Zone = 0
15	15.0						
		5.0 / 5.0	MC4			0 0 0 0 0	15-20 ft Breathing Zone = 0
20	20.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0468 SHEET 2 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation — LOCATION : WVSU, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- — START : 10/24/14 10:10 — END : 10/24/14 13:10 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0					0	
						0	
		3.5 / 5.0	MC5	**Sandy Clay (CL)** 22.0-23.5' - brown, moist, soft, clay with some very fine grained sand		0	20-25 ft Breathing Zone = 0
				23.5-25.0' - no recovery			
25	25.0						
		3.0 / 5.0	MC6	**Sandy Clay (CL)** 25.0-28.0' - brown, moist, soft, sandy clay with interbedded sand lenses, very fine grained sand		0	25-30 ft Breathing Zone = 0
						0	
						0	
				28.0-30.0' - no recovery			
30	30.0						
		4.0 / 5.0	MC7	**Silty Clay (CL)** 30.0-30.5' - gray, moist, soft, clay with little silt		0	
				Clayey Sand (SC) 30.5-32.0' - gray, wet, loose, fine grainded, sand with little clay, clay lenses through out ~ 0.01' thick		0	
				Sand (SP) 32.0-33.0' - orange, wet, medium grained, poorly graded		0	
				Sand (SP) 33.0-34.0' - gray, wet, medium grained, poorly graded		0	Sample collected GW01-0468-102414 from 32-36 ft bgs 30-35 ft Breathing Zone = 0
				34.0-35.0' - no recovery			
35	35.0						
		4.0 / 5.0	MC8	**Silty Sand (SM)** 35.0-35.5' - gray and orange, wet, loose to medium dense, fine to medium grained, sand with some silt		0	
				Silty Clay (CL) 35.5-36.0' - gray, wet, soft, clay with little silt		0	
				Silty Sand (SM) 36.0-37.0' - orange, wet, loose, medium grained sand with little silt, poorly graded		0	35-40 ft Breathing Zone = 0
				Silty Clay Lense 37.0-37.2' - brown, wet, soft		0	
				Sand (SP) 37.2-37.5' - wet, loose, with black shale fragments			
40	40.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0468 SHEET 3 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation LOCATION : WVSU, Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- START : 10/24/14 10:10 END : 10/24/14 13:10 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	40.0			**Silty Sand (SM)** 37.5-39.0' - brown, wet, medium dense, fine to medium grained sand with little silt		0	
				39.0-40.0' - no recovery			
		3.0 5.0	MC9	**Silty Sand (SM)** 40.0-41.5' - brown, wet, medium dense, medium grained sand with little silt, sandstone cobble at 40.3-40.5', poorly graded		0 0	
				Silty Sand (SM) 41.5-43.0' - gray and black layering, wet, medium dense, medium grained sand with little silt, poorly graded			Sample collected GW02-0468-102414 from 41-45 ft bgs 40-45 ft Breathing Zone = 0
				43.0-45.0' - no recovery			
45	45.0						
		3.0 3.0	MC10	**Silty Sand (SM)** 45.0-48.0' - gray, wet, medium dense, medium grained sand with trace silt, poorly graded		0 0	45-50 ft Breathing Zone = 0
	48.0					0	
				Bottom of Boring at 48.0 ft below ground surface			gray sandstone in drill shoe at refusal Refusal at 48.0 ft
50							
55							
60							

February 2015

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
650363	0469	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation — LOCATION : WVSU, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- — START : 2/10/15 09:15 — END : 2/10/15 11:15 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID Initial (ppm)	PID Headspace (ppm)	COMMENTS
		5.0 / 5.0	MC1	**Fill** 0.0-5.0' - rock (cobble/debris), silty clay, gravel				0-5' Airknife 0-5 ft Breathing Zone = 0 Area is covered by fill - rocks, debris, trace wood, had to attempt airknifing several times to get through
5	5.0							
		2.5 / 5.0	MC2	**Fill** 5.0-7.5' - gravel, brick, wood, plastic material and some silty clay and sand		0 0	0 0	5-10 ft Breathing Zone = 0
				7.5-10.0' - no recovery				
10	10.0							
		3.5 / 5.0	MC3	**Gravelly Silty Clay (CL)** 10.0-11.0' - brown, wet, stiff, clay with some angular gravel and some silt		0	0	
				Concrete 11.0-11.5' - dry, crumbled, brittle		0	0	
				Gravelly Silty Clay (CL) 11.5-13.5' - brown, moist, stiff, clay with some gravel, brick, plastic, burlap material, and some silt		0	0	10-15 ft Breathing Zone = 0
				13.5-15.0' - no recovery				
15	15.0							
		3.0 / 5.0	MC4	**Gravelly Sandy Clay (CL)** 15.0-16.5' - brown, moist, stiff, clay with some gravel and little coarse grained sand with some white plastic		0	0	
				Clay and Fly Ash 16.5-18.0' - alternating layers about 0.05 inches each - wet, black flyash, brown clay, medium stiff		0 0	0 0	15-20 ft Breathing Zone = 0
				18.0-20.0' - no recovery				
20	20.0							
				Silty Clay (CL) 20.0-23.5' - dark brown, moist, medium stiff to soft, medium plasticity, clay with some silt		0	0	

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
650363	0469	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation — LOCATION : WVSU, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- — START : 2/10/15 09:15 — END : 2/10/15 11:15 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID Initial (ppm)	PID Headspace (ppm)	COMMENTS
		3.5 / 5.0	MC5			0 0	0 0	20-25 ft Breathing Zone = 0
				23.5-25.0' - no recovery				
25	25.0							
				Sandy Clay (CL) 25.0-27.5' - dark brown, moist, soft, medium plasticity, clay with small sand lens, very fine grained sand		0 0	0 0	
		3.5 / 5.0	MC6	**Clayey Sand (SC)** 27.5-28.5' - dark brown, moist, medium dense, very fine grained sand with some clay		0	0	25-30 ft Breathing Zone = 0
				28.5-30.0' - no recovery				
30	30.0							
				Sand and Sandy Clay (SC-CL) 30.0-33.0' - dark brown, moist to wet, medium stiff, medium dense, sand and sandy clay alternating layers, wet at 31.0', small gravel layer at 31.0'		0 0	0 0	
		3.5 / 5.0	MC7			0	0	
				Sandstone cobbles and Clayey Sand 33.0-33.5' - wet, medium dense, coarse grained, sand with little clay and cobbles				30-35 ft Breathing Zone = 0
				33.5-35.0' - no recovery				
35	35.0							
				Silty Sand (SM) 35.0-37.0' - brown, wet to saturated, loose, fine to medium grained sand with some silt				
		2.0 / 2.0	MC8					35-37 ft Breathing Zone = 0
	37.0							
				Bottom of Boring at 37.0 ft below ground surface				Refusal at 37.0 ft
40								

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0470 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation LOCATION : WVSU, Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- START : 2/11/15 09:15 END : 2/11/15 11:45 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID Initial (ppm)	PID Headspace (ppm)	COMMENTS
				Grass 0.0-0.3'				0-5' Airknife
				Gravelly Silt Sand 0.3-5.0' - brown, dry to moist				
		0.0 / 5.0	MC1					0-5 ft Breathing Zone = 0
5	5.0							
				Sandy Gravelly Clay (CL) 5.0-8.0' - brown, moist to dry, medium stiff, clay with little sand and some gravel, including a brick at 6.0'		0	0	
						0	0	
		5.0 / 5.0	MC2			0	0	5-10 ft Breathing Zone = 0
				Fly Ash 8.0-13.5' - very fine grained black material with white specks, dry then wet at 11.0', medium stiff		0	0	
10	10.0					0	0	
						0	0	
						0	0	
		3.5 / 5.0	MC3			0	0	
				13.5-15.0' - no recovery				10-15 ft Breathing Zone = 0
15	15.0							
				Fly Ash 15.0-19.0' - very fine grained black to dark gray material with white specks, wet, soft, small blebs of rainbow sheen beginning at 17.0-19.0'		0	0	
						0	0	
		4.0 / 5.0	MC4			0	0	15-20 ft Breathing Zone = 0
						0	0	
				19.0-20.0' - no recovery				
20	20.0							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
650363	0470	SHEET 2 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation — LOCATION : WVSU, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- — START : 2/11/15 09:15 — END : 2/11/15 11:45 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID Initial (ppm)	PID Headspace (ppm)	COMMENTS
	20.0			**Fly Ash** 20.0-23.2' - very fine grained black to dark gray material with white specks, wet, soft, small blebs of rainbow sheen from 20.0-21.5'		0	0	
						0	0	
		3.2 / 5.0	MC5			0	0	
				23.2-25.0' - no recovery				20-25 ft Breathing Zone = 0
25	25.0							
				Fly Ash 25.0-28.5' - very fine grained black to dark gray material with white specks, wet, soft, small blebs of rainbow sheen at 26.0', sandy gravel from 28.0-28.2'		0	0	
						0	0	
		3.5 / 5.0	MC6			0	0	25-30 ft Breathing Zone = 0
				28.5-30.0' - no recovery				
30	30.0							
				Sandy Fly Ash 30.0-34.5' - black, wet, loose, coarser than previous, rainbow sheen at 34.5', odor		0	0	
						0	0.1	
		5.0 / 5.0	MC7			0	0	
						0	0.6	30-35 ft Breathing Zone = 0
35	35.0			**Silty Clay (CL)** 34.5-35.0' - dark brown, soft, medium plasticity, clay with little silt		0	1.8	
				Sandy Clay (CL) 35.0-37.5' - brown, wet, soft, clay with fine grained sand lenses		0	0	
						0	0	
		3.5 / 5.0	MC8			0	0	
				Silty Clay (CL) 37.5-38' - brown and gray mottled, medium stiff, clay with some silt				35-40 ft Breathing Zone = 0
				Clayey Sand (SC) 38-38.5' - brown, wet, loose, sand with small clay lenses, fine grained				
40	40.0			38.5-40.0' - no recovery				

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0470 SHEET 3 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation LOCATION : WVSU, Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- START : 2/11/15 09:15 END : 2/11/15 11:45 LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID Initial (ppm)	PID Headspace (ppm)	COMMENTS
	40.0			**Gravelly Silty Sand (SW-SM)** 40.0-40.5' - brown, wet, loose, medium grained sand with some gravel and some silt		0	0	
				Silty Clay (CL) 40.5-42.0' - brown, wet, soft, medium plasticity, clay with little silt		0	0	
		5.0 5.0	MC9	**Silty Sand (SM-CL)** 42.0-45.0' - brown, wet, medium dense, with clay lenses, medium grained sand with some silt and clay with little silt		0	0	40-45 ft Breathing Zone = 0
						0	0	
45	45.0					0	0	
				Sandy Clay (CL) 45.0-47.5' - brown, wet, soft, clay with some fine to medium grained sand		0	0	
						0	0	
		5.0 5.0	MC10	**Gravelly Silty Sand (SM)** 47.5-51.5' - gray, wet, loose to medium dense, medium to coarse grained sand with some gravel and little silt		0	0	45-50 ft Breathing Zone = 0
						0	0	
50	50.0					0	0	
						0		
		3.0 3.0	MC11	**Sandy Gravel (GW)** 51.5-53.0' - brown and gray, wet, dense, cobbles with some coarse grained sand		0		50-53 ft Breathing Zone = 0
	53.0					0		
				Bottom of Boring at 53.0 ft below ground surface				Refusal at 53.0 ft
55								
60								

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
650363	0471 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation — LOCATION : WVSU, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- — START : 2/11/15 15:15 — END : 2/11/15 11:20 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID Initial (ppm)	PID Headspace (ppm)	COMMENTS
		0.0 / 5.0	MC1	**Fill** 0.0-0.3' - grass **Silty Sand (SP)** 0.3-5.0' - brown, moist				0-5' Airknife 0-5 ft Breathing Zone = 0
5	5.0							
		5.0 / 5.0	MC2	**Sandy Silt (ML)** 5.0-6.5' - brown, moist, stiff, silt with little fine grained sand, gravel at 6.0' **Silty Clay (CL)** 6.5-21.5' - brown, moist, stiff, clay with little silt		0 0 0 0 0 0	0 0 0 0 0 0	5-10 ft Breathing Zone = 0
10	10.0							
		5.0 / 5.0	MC3			0 0 0 0 0 0	0 0 0 0 0 0	10-15 ft Breathing Zone = 0
15	15.0							
		5.0 / 5.0	MC4			0 0 0 0 0 0	0 0 0 0 0 0	15-20 ft Breathing Zone = 0
20	20.0							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
650363	0471	SHEET 2 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation — LOCATION : WVSU, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- — START : 2/11/15 15:15 — END : 2/11/15 11:20 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID Initial (ppm)	PID Headspace (ppm)	COMMENTS
	20.0					0	0	
				Sandy Silt (ML) 21.5-23.0' - brown, moist, medium stiff, silt with some very fine grained sand		0	0	
		5.0 5.0	MC5			0	0	
				Sandy Clay (CL) 23.0-28.0' - brown, moist, soft, clay with some very fine grained sand		0	0	20-25 ft Breathing Zone = 0
25	25.0					0	0	
						0	0	
						0	0	
		3.0 5.0	MC6			0	0	25-30 ft Breathing Zone = 0
				28.0-30.0' - no recovery				
30	30.0							
				Sandy Clay (CL) 30.0-30.5' - brown, moist, soft, clay with some very fine grained sand		0	0	
				Silty Sand (SM) 30.5-31.5' - brown, wet, very loose, very fine grained sand and silt		0	0	
		5.0 5.0	MC7	**Sandy Clay (CL)** 31.5-33.5' - brown, wet, soft, clay with some very fine grained sand		0	0	30-35 ft Breathing Zone = 0
				Silty Sand (SM) 33.5-35.5' - brown/orange, wet, medium dense, medium to coarse grained sand with little silt		0	0	
35	35.0					0	0	
				Silty Sand (SM) 35.5-38.5' - orange, wet, very loose to loose, fine to medium grained sand and silt		0	0	
						0	0	
		3.5 5.0	MC8			0	0	35-40 ft Breathing Zone = 0
				38.5-40.0' - no recovery				
40	40.0							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
650363	0471	SHEET 3 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Delineation — LOCATION : WVSU, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface Inc.

DRILLING METHOD AND EQUIPMENT : Direct Push 9500 Power Probe VTR

WATER LEVELS : --- — START : 2/11/15 15:15 — END : 2/11/15 11:20 — LOGGER : D. Roberts

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID Initial (ppm)	PID Headspace (ppm)	COMMENTS
	40.0			**Silty Sand (SM)** 40.0-42.0' - orange, wet, very loose to loose, fine to medium grained sand and silt		0	0	
						0	0	
		5.0 / 5.0	MC9	**Sandy Clay (CL)** 42.0-43.5' - dark brown, wet, soft, clay with trace of very fine grained sand		0	0	40-45 ft Breathing Zone = 0
				Silty Sand (SM) 43.5-48.5' - dark brown, wet, medium dense, fine grained sand with little silt, black shale at 48.0'		0	0	
45	45.0					0	0	
						0	0	
						0	0	
		3.5 / 5.0	MC10			0	0	45-50 ft Breathing Zone = 0
				48.5-50.0' - no recovery				
50	50.0							
	51.0	1.0 / 1.0	MC11	**Sand and Sandstone cobbles (SP)** 50.0-51.0' - brown and gray, wet, hard, coarse grained sand		0	0	50-51 ft Breathing Zone = 0
				Bottom of Boring at 51.0 ft below ground surface				Refusal at 51.0 ft
55								
60								

June 2015

PROJECT NUMBER:	BORING NUMBER:
650363	TW-102 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Investigation | LOCATION : East Boundary, Institute, WV

ELEVATION : | DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- | START : 7/9/15 13:15 | END : 7/9/15 14:30 | LOGGER : Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		5.0 / 5.0	HA-1	**Lean Clay (CL)** 0.0-8.0' - brown, moist		0 0 0.2 0.4	
5	5.0					0.4	
		5.0 / 5.0	DPT-2			0 0 0 0	
				Silty Sand (SM) 8.0-12.4' - light brown, wet, dense		0	▼ Depth to water = 8'
10	10.0					0	
		5.0 / 5.0	DPT-3			0 0 0	
				Sandy Clay (CL) 12.4-13.5' - brown, wet, stiff		0	
				Lean Clay (CL) 13.5-18.5' - brown, moist, very stiff		0	
15	15.0					0	
		4.0 / 5.0	DPT-4			0 0 0 0	
				Sandy Clay (CL) 18.5-19.0' - brown, moist to wet, medium stiff		0	
20	20.0			19.0-20.0' - no recovery			

PROJECT NUMBER:	BORING NUMBER:
650363	TW-102 SHEET 2 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 7/9/15 13:15 — END : 7/9/15 14:30 — LOGGER : Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0			**Sandy Clay (CL)** 20.0-21.0' - brown, moist to wet, medium stiff		0	
				Lean Clay (CL) 21.0-22.0' - brown, moist, stiff		0	
		5.0 / 5.0	DPT-5	**Clay with shale gravel (CH)** 22.0-25.0' - clay is brown, shale is green, moist, very stiff		0 0 0	
25	25.0						
				Clay (CH) 25.0-26.0' - brown, moist, stiff		0	
				Clay with shale gravel (CH) 26.0-29.0' - clay is brown, shale is green, moist, very stiff, possible fill		0 0 0	
		4.0 / 5.0	DPT-6				
				29.0-30.0' - no recovery			
30	30.0						
				Clay with shale gravel (CH) 30.0-31.5' - clay is brown, shale is green, moist, very stiff, possible fill		0	
				Lean Clay (CL) 31.5-32.5' - brown, moist, stiff, with sand		0	
		3.0 / 5.0	DPT-7	**Clay (CH)** 32.5-33.0' - gray, moist, medium stiff		0	
				33.0-35.0' - no recovery			
35	35.0						
				Clay (CH) 35.0-36.5' - gray, moist, medium stiff		0	
				Sand (SP) 36.5-36.8' - tan, moist, dense		0	
		3.0 / 5.0	DPT-8	**Clay (CH)** 36.8-38.0' - gray, moist, medium stiff		0	
				38.0-40.0' - no recovery			
40	40.0						

PROJECT NUMBER:	BORING NUMBER:
650363	TW-102 SHEET 3 OF 3

SOIL BORING LOG

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 7/9/15 13:15 — END : 7/9/15 14:30 — LOGGER : Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	40.0			**Sand with silt (SM)** 40.0-40.8' - gray, wet, medium dense, poorly graded, fine grained		0	
				Sandy Clay (CH) 40.8-42.2' - brownish gray, moist, stiff		0	
		5.0/5.0	DPT-9	**Clay (CH)** 42.2-43.5' - gray, moist, very stiff		0	
				Sandy Clay (CH) 43.5-44.5' - gray, moist, medium stiff		0	
45	45.0			**Clay (CH)** 44.5-49.5' - gray, moist, very stiff		0	
		4.5/5.0	DPT-10			0	
						0	
						0	
						0	
						0	
50	50.0			49.5-50.0' - no recovery			
				Clay (CH) 50.0-54.5' - gray, moist, very stiff			
		4.5/5.0	DPT-11				
55	55.0			54.5-55.0' - no recovery			
		2.0/2.0	DPT-12	**Clay (CH)** 55.0-56.3' - gray, moist, very stiff			
	57.0			**Sandy Clay (CL)** 56.3-56.6' - gray, wet, medium stiff			
				Clayey Sand with gravel (SC) 56.6-57.0' - gray, wet, dense			
				Bottom of Boring at 57.0 ft below ground surface			
60							

PROJECT NUMBER:	BORING NUMBER:
650363	TW-103 SHEET 1 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 7/8/15 11:20 — END : 7/8/15 15:00 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
		0.0 / 5.0	DP-1	0.0-5.0' - no recovery - due to air-knifing			Breathing Zone = 0.0 ppm	PVC 2"
5	5.0						Breathing Zone = 0.0 ppm	
		5.0 / 5.0	DP-2	**Silty Clay (ML-CL)** 5.0-7.5' - reddish brown, damp, stiff		0	Breathing Zone = 0.0 ppm	
				Sandy Silt (ML) 7.5-9.0' - reddish brown, damp, soft, with some clay		0	Breathing Zone = 0.0 ppm	
10	10.0			**Silty Clay (ML-CL)** 9.0-18.5' - tan to gray, damp, stiff to very stiff, 2" sand strings at 12.25' and 13'		0		
		5.0 / 5.0	DP-3			0	Breathing Zone = 0.0 ppm	
15	15.0					0	Breathing Zone = 0.0 ppm	
		5.0 / 5.0	DP-4			0	Breathing Zone = 0.0 ppm	
						0	Depth to water = 18-21'	
				Silty Clayey Sand (SM-SC) 18.5-19.0' - reddish brown, damp to wet, loose, sand is fine grained		0	Breathing Zone = 0.0 ppm	
20	20.0							

PROJECT NUMBER:	BORING NUMBER:
650363	TW-103 SHEET 2 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 7/8/15 11:20 — END : 7/8/15 15:00 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
	20.0			**Sandy Clay (CL)** 19.0-21.5' - gray, wet, soft		0		
		5.0 / 5.0	DP-5	**Silty Clayey Sand (SM-SC)** 21.5-22.5' - brown, wet, loose		0		cement bentonite grout
				Sandy Clay (SM-CL) 22.5-29.0' - tan to gray, wet to damp, soft to stiff, grades to silty clay, SM-SC strings at 25' (4") and 26.5' (2")		0		
25	25.0					0	Breathing Zone = 0.0 ppm	
		5.0 / 5.0	DP-6			0	Breathing Zone = 0.0 ppm	
				Silty Clayey Sand (SM-SC) 29.0-30.0' - gray, wet, loose		0		
30	30.0			**Sand (SP)** 30.0-30.6' - gray, wet, dense, poorly graded, fine grained, some silt		0		
				Sandy Gravel (GP) 30.6-30.9' - gray, wet, very dense		0		
		5.0 / 5.0	DP-7	**Lean Clay (CL)** 30.9-35.0' - brown, moist, stiff		0	Breathing Zone = 0.0 ppm	
35	35.0					0		
				Silty Sand (SM) 35.0-36.2' - gray, wet, dense		0		
				Lean Clay (CL) 36.2-42.0' - brown with gray bands, moist, stiff, few sand partings		0		
		5.0 / 5.0	DP-8			0	Breathing Zone = 0.0 ppm	
40	40.0					0		

PROJECT NUMBER:	BORING NUMBER:
650363	TW-103 SHEET 3 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 7/8/15 11:20 — END : 7/8/15 15:00 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
40.0						0		
						0		
		5.0 / 5.0	DP-9	**Silty Sand (SM)** 42.0-42.3' - brown, moist, dense		0	Breathing Zone = 0.0 ppm	
				Lean Clay (CL) 42.3-43.0' - brown, moist, stiff, high mica		0		
				Silty Sand (SM) 43.0-44.5' - brown, wet, medium dense		0		bentonite
45 45.0				**Sandy Clay (CL)** 44.5-45.4' - dark gray, wet, soft		0		
				Silty Sand (SM) 45.4-47.5' - gray, wet, medium dense		0		
						0		
		5.0 / 5.0	DP-10			0	Breathing Zone = 0.0 ppm	
				Sandy Clay (CL) 47.5-48.0' - gray with brown, moist, stiff		0		
				Sand (SP) 48.0-48.3' - gray, wet, loose, poorly graded		0		
				Clay (CH) 48.3-49.5' - gray, moist, stiff		0		
50 50.0				**Clayey Sand (SC)** 49.5-51.0' - gray, wet, loose		0		
						0		#5 sand
				Silty Sand (SM) 51.0-52.5' - gray, wet, loose		0	Breathing Zone = 0.0 ppm	
		4.5 / 4.5	DP-11			0		PVC 2" 0.010" slot size
				Clay (CH) 52.5-54.1' - gray, moist, stiff		0		
54.5								
55				**Sand (SP)** 54.1-54.5' - gray, wet, dense, poorly graded, fine grained				
				Bottom of Boring at 54.5 ft below ground surface				
60								

PROJECT NUMBER:	BORING NUMBER:
650363	TW-104 SHEET 1 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 6/23/15 15:00 — END : 6/23/15 17:50 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
		0.0 / 5.0	DP-1	0.0-5.0' - no recovery - due to air-knifing			Breathing Zone = 0.0 ppm	PVC 2"
5	5.0						Breathing Zone = 0.0 ppm	
		5.0 / 5.0	DP-2	**Silty Clay (ML-CL)** 5.0-7.5' - brown to black, damp, medium stiff		0 0	Breathing Zone = 0.0 ppm	
				Clay (CL) 7.5-10.0' - tan to gray, damp, very stiff, with occasional silt		0 0 0		
10	10.0							
		4.0 / 5.0	DP-3	10.0-11.0' - no recovery				
				Clayey Silt (CL-ML) 11.0-13.5' - brown, damp, soft to medium stiff, with fine sand		0 0		
				Clayey Silty Sand (SC-SM) 13.5-15.0' - brown to gray, damp to wet at 15', loose, sand is fine grained, with occasional clay lenses (~0.5-1.0")		0 0		
15	15.0						▼ Dept to water = 15'	
		3.5 / 5.0	DP-4	15.0-16.5' - no recovery			Run M probe but hole callapsed, switch to piston stopper	
				Silty Sand (SM) 16.5-25.0' - tan to orange, wet, loose, sand is fine to medium grained		0 0	Breathing Zone = 0.0 ppm	
20	20.0							

PROJECT NUMBER:	BORING NUMBER:
650363	TW-104 SHEET 2 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 6/23/15 15:00 — END : 6/23/15 17:50 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
	20.0					0		cement bentonite grout
		5.0 / 5.0	DP-5			0	Breathing Zone = 0.0 ppm	
						0		
25	25.0					0		
				25.0-27.5' - no recovery				
		2.5 / 5.0	DP-6	**Silty Sand (SM)** 27.5-30.0' - tan to orange to brown, wet, loose, sand is fine to medium grained		0	Breathing Zone = 0.0 ppm	
						0		
30	30.0						Breathing Zone = 0.0 ppm	
				Clayey Silt to Silty Clay (CL-ML) 30.0-35.0' - gray to reddish gray, wet, very soft, with silt fines and occasional fine sand partings (<1mm)		0		
		5.0 / 5.0	DP-7			0	Breathing Zone = 0.0 ppm	
						0		
35	35.0					0		
				Silty Clayey Sand (SM-SC) 35.0-36.0' - gray, wet, loose, sand is fine grained		0		
				Silty Clayey Sand (CL) 36.0-37.5' - gray, wet, soft, with fine grained sand		0		
		5.0 / 5.0	DP-8			0	Breathing Zone = 0.0 ppm	
				Silty Clayey Sand (SM-SC) 37.5-38.0' - gray, wet, loose, sand is fine grained		0		
				Silty Clay (ML-CL) 38.0-40.0' - gray, damp, medium stiff		0		
40	40.0					0		

PROJECT NUMBER:	BORING NUMBER:
650363	TW-104 SHEET 3 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 6/23/15 15:00 — END : 6/23/15 17:50 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
	40.0			40.0-41.0' - no recovery			Breathing Zone = 0.0 ppm	
		4.0 / 5.0	DP-9	**Silty Clayey Sand (SM-SC)** 41.0-43.0' - gray, wet, loose, sand is fine grained, close to CL-ML		0		bentonite
						0	Breathing Zone = 0.0 ppm	
				Silty Clay (ML-CL) 43.0-43.5' - gray, wet, soft		0		
				Sand (SP) 43.5-48.0' - gray, wet, medium dense, sand is fine grained		0		
45	45.0					0	Breathing Zone = 0.0 ppm	
		5.0 / 5.0	DP-10			0		
						0		
				Clayey Sandy Silt (CL-ML) 48.0-49.0' - gray, wet, soft		0		
				Sand (SP) 49.0-50.0' - gray, wet, stiff, sand is fine grained		0		#5 sand
50	50.0							PVC 2" 0.010" slot size
		0.0 / 3.5	DP-11	50.0-53.5' - no recovery			Breathing Zone = 0.0 ppm	
	53.5							
				Bottom of Boring at 53.5 ft below ground surface			Refusal at 53.5 ft	
55								
60								

PROJECT NUMBER:	BORING NUMBER:
650363	TW-105 SHEET 1 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface/Cascade

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 6/26/15 08:45 — END : 6/26/15 10:35 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
		0.0 / 5.0	DP-1	0.0-5.0' - no recovery - due to air-knifing		0	Breathing Zone = 0.0 ppm	PVC 2"
5	5.0						Breathing Zone = 0.0 ppm	
		5.0 / 5.0	DP-2	**Silty Clay (ML-CL)** 5.0-6.5' - tan to gray, dry, medium stiff		0		
				Silty Clayey Sand (SM-SC) 6.5-9.5' - tan to gray (mottled), dry to damp, medium dense		0	Breathing Zone = 0.0 ppm	
						0		
						0	Breathing Zone = 0.0 ppm	
10	10.0			**Sand (SP)** 9.5-13.25' - orangish brown, dry to damp, loose, sand is fine grained		0		
		5.0 / 5.0	DP-3			0		
						0	Breathing Zone = 0.0 ppm	
				Silty Clay (ML-CL) 13.25-14.0' - brown to tan, damp to stiff, very stiff		0		
				Silty Sand (SM) 14.0-15.0' - brown, dry, loose, sand is fine grained		0	Breathing Zone = 0.0 ppm	
15	15.0							
		5.0 / 5.0	DP-4	**Silty Clay (ML-CL)** 15.0-15.25' - light brown, damp, medium stiff		0	▼ Depth to water = 15'	
				Silty Sand (SM) 15.25-17.0' - light brown, saturated, damp to wet		0		
				Sandy Clay (SC-CL) 17.0-18.0' - light brown, damp to wet, soft		0	Breathing Zone = 0.0 ppm	
				Silty Sand (SM) 18.0-20.0' - light brown, wet, loose, sand is fine grained		0		
20	20.0					0	Breathing Zone = 0.0 ppm	

PROJECT NUMBER:	BORING NUMBER:
650363	TW-105 SHEET 2 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface/Cascade

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 6/26/15 08:45 — END : 6/26/15 10:35 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
	20.0			20.0-21.0' - no recovery				
		4.0 / 5.0	DP-5	**Silty Sand (SM)** 21.0-21.5' - light brown, wet, loose, sand is fine grained **Silty Clayey Sand (SM-SC)** 21.5-23.0' - light brown, wet, soft		0 0	Breathing Zone = 0.0 ppm	cement bentonite grout
				Silty Clay (ML-CL) 23.0-25.0' - light brown, damp, soft		0 0	Breathing Zone = 0.0 ppm	
25	25.0			25.0-26.0' - no recovery				
		4.0 / 5.0	DP-6	**Sandy Silty Clay (ML-CL)** 26.0-28.0' - light brown, damp, soft		0 0		
				Silty Clayey Sand (SM-SC) 28.0-29.0' - light brown, wet, loose		0		
30	30.0			**Silty Clay (ML-CL)** 29.0-30.0' - light brown, damp, medium stiff		0		
		5.0 / 5.0	DP-7	**Sandy Clay (SC-CL)** 30.0-33.5' - light brown, wet, soft		0 0 0	Breathing Zone = 0.0 ppm	
				Silty Clayey Sand (SM-SC) 33.5-37.0' - light brown, wet, medium dense, sand is fine grained		0 0 0	Breathing Zone = 0.0 ppm Breathing Zone = 0.0 ppm	
35	35.0							
		5.0 / 5.0	DP-8	**Silty Sand (SM)** 37.0-45.0' - light brown to gray, wet, loose, sand is fine grained, sandy clay lenses ~ 0.7" thick at 41.5', 43' and 44.5'		0 0 0	Breathing Zone = 0.0 ppm	
40	40.0							

PROJECT NUMBER:	BORING NUMBER:
650363	TW-105 SHEET 3 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface/Cascade

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 6/26/15 08:45 — END : 6/26/15 10:35 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
	40.0					0		
		5.0 / 5.0	DP-9			0		
						0	Breathing Zone = 0.0 ppm	
						0		
						0	Breathing Zone = 0.0 ppm	
45	45.0			**Silty Sand (SM)** 45.0-47.0' - light brown to gray, wet, loose, sand is fine grained		0		bentonite
						0		
		5.0 / 5.0	DP-10	**Clayey Sand (SC)** 47.0-48.0' - gray, wet, loose, sand is fine grained		0		
				Sand (SP) 48.0-50.0' - gray, wet, stiff, sand is fine grained		0		
50	50.0					0		
				50.0-54.0' - no recovery			Breathing Zone = 0.0 ppm	#5 sand
		0.0 / 4.0	DP-11					PVC 2" 0.010" slot size
	54.0						Breathing Zone = 0.0 ppm	
55				Bottom of Boring at 54.0 ft below ground surface			Refusal at 54.0 ft	
60								

PROJECT NUMBER:	BORING NUMBER:
650363	TW-106 SHEET 1 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 6/29/15 09:15 — END : 6/29/15 11:30 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
		0.0 / 5.0	DP-1	0.0-5.0' - no recovery - due to air-knifing			Breathing Zone = 0.0 ppm	PVC 2"
5	5.0	5.0 / 5.0	DP-2	**Silty Clayey Sand (SM-SC)** 5.0-8.5' - orangish brown, damp, medium dense		0	Breathing Zone = 0.0 ppm	
						0		
						0		
				Sand (SP) 8.5-13.0' - orangish brown, damp, loose		0	Breathing Zone = 0.0 ppm	
10	10.0					0		
		3.0 / 5.0	DP-3			0	Breathing Zone = 0.0 ppm	
						0		
				13.0-15.0' - no recovery				
15	15.0						Breathing Zone = 0.0 ppm	
		2.5 / 5.0	DP-4	**Sand (SP)** 15.0-17.5' - orangish brown, damp to wet, loose, sand is fine grained		0		
						0	▼ Depth to water = 16'	
				17.5-22.0' - no recovery			Breathing Zone = 0.0 ppm	
20	20.0							

PROJECT NUMBER:	BORING NUMBER:
650363	TW-106 SHEET 2 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation LOCATION : East Boundary, Institute, WV

ELEVATION : DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- START : 6/29/15 09:15 END : 6/29/15 11:30 LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
	20.0							cement bentonite grout
		3.0/5.0	DP-5	**Sand (SP)** 22.0-29.0' - light brown to gray, wet, loose, sand is fine grained		0 0 0	Breathing Zone = 0.0 ppm	
25	25.0							
		4.0/5.0	DP-6			0 0 0 0 0	Breathing Zone = 0.0 ppm	
				29.0-30.0' - no recovery				
30	30.0							
		5.0/5.0	DP-7	**Sand (SP)** 30.0-35.0' - gray to orange, wet, loose, sand is fine to medium grained		0 0 0 0 0	Breathing Zone = 0.0 ppm Breathing Zone = 0.0 ppm	
35	35.0							
		5.0/5.0	DP-8	**Sandy Silty Clay (ML-CL)** 35.0-45.0' - gray, damp, medium stiff, with 2" sand strings at 39', 43' and 49'		0 0 0 0 0	Breathing Zone = 0.0 ppm	
40	40.0							

PROJECT NUMBER:	BORING NUMBER:
650363	TW-106 SHEET 3 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation
LOCATION : East Boundary, Institute, WV
ELEVATION :
DRILLING CONTRACTOR : Subsurface
DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR
WATER LEVELS : ---
START : 6/29/15 09:15
END : 6/29/15 11:30
LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
	40.0	5.0 / 5.0	DP-9			0	Breathing Zone = 0.0 ppm	
45	45.0	5.0 / 5.0	DP-10	**Sandy Silty Clay (ML-CL)** 45.0-46.0' - gray, wet, soft		0	Breathing Zone = 0.0 ppm	bentonite
				Sandy Clayey Silt (SM-ML) 46.0-47.5' - gray, wet, soft		0		
				Silty Sandy Clay (ML-CL) 47.5-48.0' - gray, wet, soft		0		
50	50.0			**Sand (SP)** 48.0-50.0' - gray, wet, loose, sand is fine grained		0		
		0.0 / 5.0	DP-11	50.0-55.0' - no recovery			Breathing Zone = 0.0 ppm	#5 sand PVC 2" 0.010" slot size
55	55.0	3.0 / 3.0	DP-12	**Sand (SP)** 55.0-58.0' - gray, wet, loose, sand is fine grained		0	Breathing Zone = 0.0 ppm	
	58.0			Bottom of Boring at 58.0 ft below ground surface				
60								

PROJECT NUMBER:	BORING NUMBER:
650363	TW-107 SHEET 1 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface/Cascade

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 6/29/15 09:13 — END : 6/29/15 11:30 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
		0.0 / 5.0		0.0-5.0' - no recovery - due to air-knifing				PVC 2"
5	5.0							
		3.5 / 5.0		5.0-6.5' - no recovery **Silty fines - Flyash (ML)** 6.5-15.0' - gray, dry to wet at 11', soft		0 0 0 0 0 0 0 0	Breathing Zone = 0.0 ppm Depth to water = 11' Breathing Zone = 0.0 ppm Breathing Zone = 0.0 ppm	
10	10.0							
		5.0 / 5.0						
15	15.0							
		1.0 / 5.0		15.0-19.0' - no recovery				
				Flyash (ML) 19.0-20.0' - gray to black, wet, soft		0	Breathing Zone = 0.0 ppm	cement bentonite grout
20	20.0							

PROJECT NUMBER:	BORING NUMBER:
650363	TW-107 SHEET 2 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface/Cascade

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 6/29/15 09:13 — END : 6/29/15 11:30 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
	20.0			20.0-27.5' - no recovery				
		0.0 / 5.0					Breathing Zone = 0.0 ppm	
25	25.0							
		2.5 / 5.0		**Silty Clay (CL)** 27.5-28.0' - brown/gray mottled, damp, very stiff **Sandy Silty Clay (ML-CL)** 28.0-30.0' - brown/gray, damp, very stiff, with angular Sandstone fragments, ~ 2'sand stringer (SM) at 29'			Breathing Zone = 0.0 ppm	
30	30.0			30.0-31.0' - no recovery				
		4.0 / 5.0		**Clayey Silty Sand (SC-SM)** 31.0-34.5' - light brown, wet, loose		0 0 0	Breathing Zone = 0.0 ppm	
35	35.0			**Silty Clay (CL)** 34.5-38.0' - light brown to gray, damp, stiff		0 0 0	Breathing Zone = 0.0 ppm	
		5.0 / 5.0		**Silty Sand (SM)** 38.0-38.5' - gray, wet, loose, sand is fine grained **Silty Clay (ML-CL)** 38.5-39.5' - gray, damp, stiff		0 0 0	Breathing Zone = 0.0 ppm	bentonite
40	40.0							

PROJECT NUMBER:	BORING NUMBER:
650363	TW-107 SHEET 3 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation — LOCATION : East Boundary, Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Subsurface/Cascade

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 9500 VTR

WATER LEVELS : --- — START : 6/29/15 09:13 — END : 6/29/15 11:30 — LOGGER : Kish/Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
	40.0			**Sand (SP)** 39.5-44.0' - gray, wet, loose, sand is fine to medium grained		0	Breathing Zone = 0.0 ppm	
		5.0 / 5.0				0	Breathing Zone = 0.0 ppm	
						0		
						0		
45	45.0			**Silty Clayey Sand (SM-SC)** 44.0-45.0' - black, wet, soft, sand is fine grained		0	Breathing Zone = 0.0 ppm	
				Silty Clay (ML-CL) 45.0-45.5' - gray, wet, soft		0		#5 sand
				Silty Sand (SM-SP) 45.5-52.0' - gray, wet, loose, wood debris at 46'		0		PVC 2" 0.010" slot size
		5.0 / 5.0				0		
						0		
50	50.0					0		
		2.0 / 2.0						
	52.0			Bottom of Boring at 52.0 ft below ground surface			Refusal at 52.0 ft	
55								
60								

PROJECT NUMBER:	BORING NUMBER:
650363	TW-108 SHEET 1 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation
LOCATION : East Boundary, Institute, WV
ELEVATION :
DRILLING CONTRACTOR : Subsurface/Cascade
DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 7500 VTR
WATER LEVELS : ---
START : 7/7/15 13:40
END : 7/7/15 15:00
LOGGER : Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
		5.0 / 5.0	HA-1	**Topsoil** 0.0-0.7' **Lean Clay (CL)** 0.7-6.0' - brown, moist		0		PVC 2"
5	5.0							
		4.0 / 5.0	DP-2	**FILL - Silty Fine Sand (SM)** 6.0-9.0' - dry, medium dense, with angular gravel, sand is fine grained, black and gray bands				
				9.0-10.0' - no recovery				
10	10.0							
		3.5 / 5.0	DP-3	**FILL - Silty Fine Sand (SM)** 10.0-13.5' - dry, medium dense, with angular gravel, sand is fine grained, black and gray bands				
				13.5-15.0' - no recovery				
15	15.0							
		3.4 / 5.0	DP-4	**FILL - Silty Fine Sand (SM)** 15.0-17.0' - moist to wet, medium dense, with angular gravel, sand is fine grained, black and gray bands				
				Silt (ML) 17.0-18.0' - dark gray, wet, medium stiff				
				Sandy Lean Clay (CL) 18.0-18.5' - brown, wet, soft, possible fill				
				18.5-20.0' - no recovery				
20	20.0							

PROJECT NUMBER:	BORING NUMBER:
650363	TW-108 SHEET 2 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation | LOCATION : East Boundary, Institute, WV

ELEVATION : | DRILLING CONTRACTOR : Subsurface/Cascade

DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 7500 VTR

WATER LEVELS : --- | START : 7/7/15 13:40 | END : 7/7/15 15:00 | LOGGER : Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
	20.0	4.5 / 5.0	DP-5	**Sand (SP)** 20.0-24.5' - brown, wet, very dense, some silt, sand is fine grained and poorly graded				cement bentonite grout
25	25.0			24.5-25.0' - no recovery				
		4.0 / 5.0	DP-6	**Sand (SP)** 25.0-28.0' - brown, wet, very dense, some silt, sand is fine grained and poorly graded				
				Sandy Gravel (GP) 28.0-28.4' - brown, wet, dense				
				Sand (SP) 28.4-29.0' - yellowish brown, wet, loose, sand is fine grained and poorly graded				
30	30.0			29.0-30.0' - no recovery				
		5.0 / 5.0	DP-7	**Sand (SP)** 30.0-35.5' - yellowish brown, wet, loose, sand is fine grained and poorly graded				
35	35.0							
		5.0 / 5.0	DP-8	**Lean Clay (CL)** 35.5-38.0' - gray, moist, stiff, high mica, trace sand				
				Silty Sand (SM) 38.0-38.4' - gray, moist, stiff				
				Lean Clay (CL) 38.4-39.8' - gray, moist, stiff				
40	40.0							

PROJECT NUMBER:	BORING NUMBER:
650363	TW-108 SHEET 3 OF 3

SOIL BORING LOG AND WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation
LOCATION : East Boundary, Institute, WV
ELEVATION :
DRILLING CONTRACTOR : Subsurface/Cascade
DRILLING METHOD AND EQUIPMENT : DPT AMS Power Probe 7500 VTR
WATER LEVELS : ---
START : 7/7/15 13:40
END : 7/7/15 15:00
LOGGER : Conway

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
	40.0			**Silt (ML)** 39.8-40.0' - gray, moist, stiff				
				Clay (CL) 40.0-42.3' - gray, moist, medium stiff				
		5.0 5.0	DP-9	**Clayey Sand (SC)** 42.3-44.7' - gray, wet, medium stiff				bentonite
45	45.0			**Clay (CL)** 44.7-46.5' - gray, moist, stiff				
		5.0 5.0	DP-10	**Clayey Sand (SC)** 46.5-49.0' - gray, wet, loose				#5 sand
50	50.0			**Sand (SP)** 49.0-50.0' - gray, moist, stiff, fine, poorly graded				PVC 2" 0.010" slot size
				Lean Clay (CL) 50.0-51.0' - brown, moist, stiff				
				Sandy Lean Clay (CL) 51.0-52.0' - brown, wet				
		4.0 4.0	DP-11	**Sand (SP)** 52.0-54.0' - gray, wet, dense				
	54.0							
55				Bottom of Boring at 54.0 ft below ground surface				
60								

PROJECT NUMBER	WELL NUMBER		
650363	TW-109	SHEET 1	OF 1

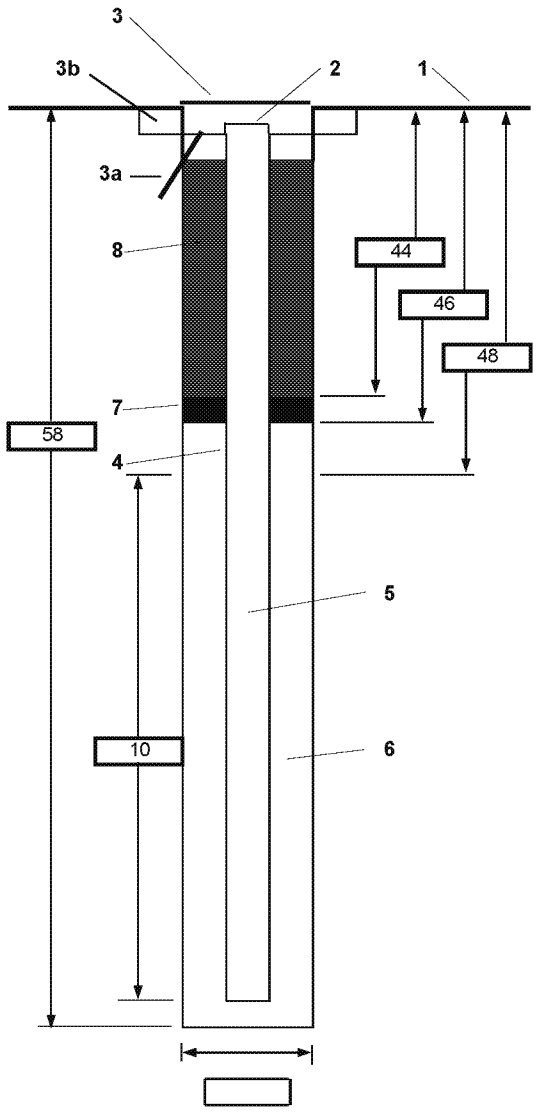
WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation LOCATION : Institute, WV

DRILLING CONTRACTOR : Cascade

DRILLING METHOD AND EQUIPMENT USED : Sonic Spider

WATER LEVELS : START : 7/23/2015 END :7/23/2015 LOGGER : W. Conway



1- Ground elevation at well: 596.5

2- Top of casing elevation: 596.25

3- Wellhead protection cover type: flushmount
- a) drain tube?: yes
- b) concrete pad dimensions: 2' x 2'

4- Dia./type of well riser: 2 inch PVC

5- Type/slot size of screen: PVC 2 inch 0.010" slot size

6- Type screen filter: #5 sand
- a) Quantity used: 275 pounds

7- Type of seal: bentonite
- a) Quantity used: 35 pounds

8- Grout
- a) Grout mix used: cement bentonite grout
- b) Method of placement: tremie
- c) Vol. of well casing grout: 50 gallons

Development method: monsoon

Development time: 40 minutes

Estimated purge volume: 65 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
650363	TW-110	SHEET 1	OF 1

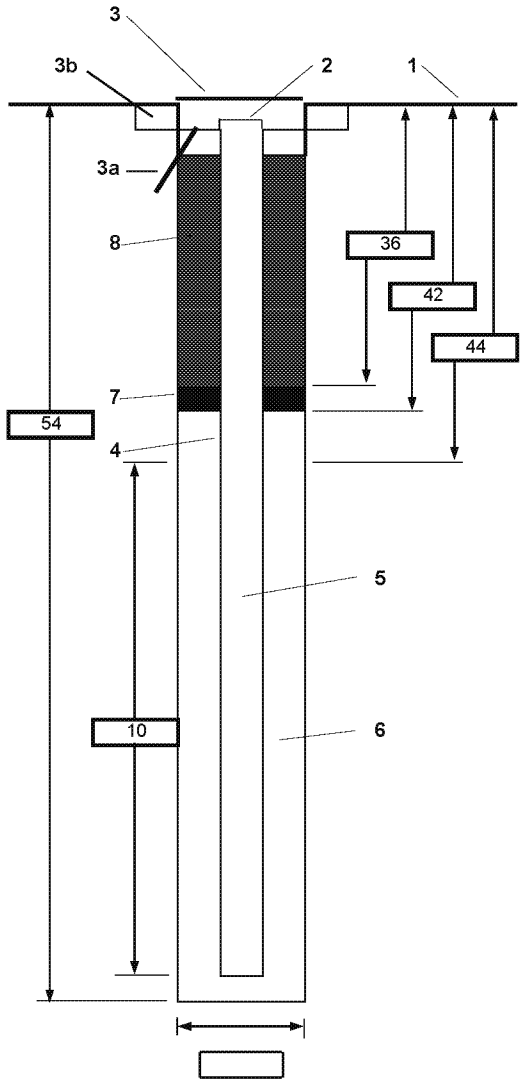
WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation LOCATION : Institute, WV

DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT USED : AMS PowerProbe VTR 6500

WATER LEVELS : START : 7/13/2015 END :7/13/2015 LOGGER : W. Conway



1- Ground elevation at well: 594.49

2- Top of casing elevation: 594.11

3- Wellhead protection cover type: Steel flushmount
- a) drain tube?: no
- b) concrete pad dimensions: 2 x 2

4- Dia./type of well riser: 2 inch PVC

5- Type/slot size of screen: 2 inch PVC, 0.010 slot

6- Type screen filter: Sand
- a) Quantity used: 50 pounds

7- Type of seal: Bentonite chips, hydrated
- a) Quantity used: 45 pounds

8- Grout
- a) Grout mix used: Cement-bentonite
- b) Method of placement: free fall
- c) Vol. of well casing grout: 450 gallons

Development method: monsoon

Development time: 1.5 hours

Estimated purge volume: 70 gallons

Comments: Sand heaving when pulling augers to 46 feet, sand used to bring sand level to 42 feet. Only 45 pounds of bentonite were placed for seal, but seal measured 6 feet. Possibly infill or bridging. Drillers did not detect bridging.

PROJECT NUMBER	WELL NUMBER		
650363	TW-111	SHEET 1	OF 1

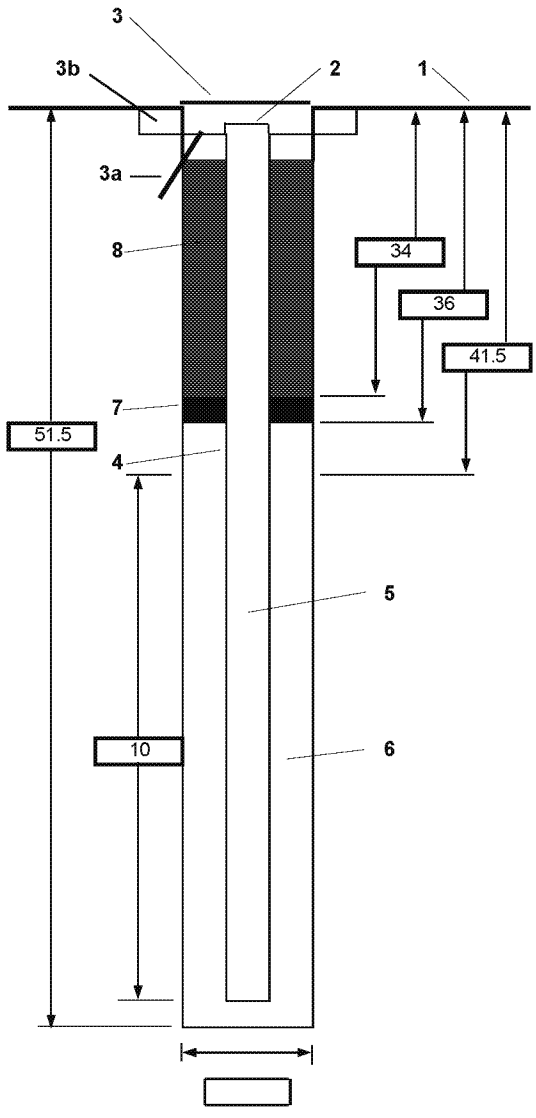
WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation LOCATION : Institute, WV

DRILLING CONTRACTOR : Subsurface

DRILLING METHOD AND EQUIPMENT USED : AMS PowerProbe VTR 6500

WATER LEVELS : START : 7/14/2015 END :7/14/2015 LOGGER : W. Conway



1- Ground elevation at well: 594.63

2- Top of casing elevation: 594.29

3- Wellhead protection cover type: Steel
- a) drain tube?: yes
- b) concrete pad dimensions: 2' x 2'

4- Dia./type of well riser: 2 inch PVC

5- Type/slot size of screen: 2 inch PVC 0.010"

6- Type screen filter: sand
- a) Quantity used: none

7- Type of seal: bentonite chips
- a) Quantity used: 40 pounds

8- Grout
- a) Grout mix used: cement bentonite grout
- b) Method of placement: freefall
- c) Vol. of well casing grout: 270 gallons

Development method: monsoon

Development time: 1 hour

Estimated purge volume: 70 gallons

Comments: Sand heave filled boring to 36 feet bgs. No sand was used. Discussed with Subsurface a different method to attempt to get sand into the well screen interval.

PROJECT NUMBER	WELL NUMBER		
650363	TW-112	SHEET 1	OF 1

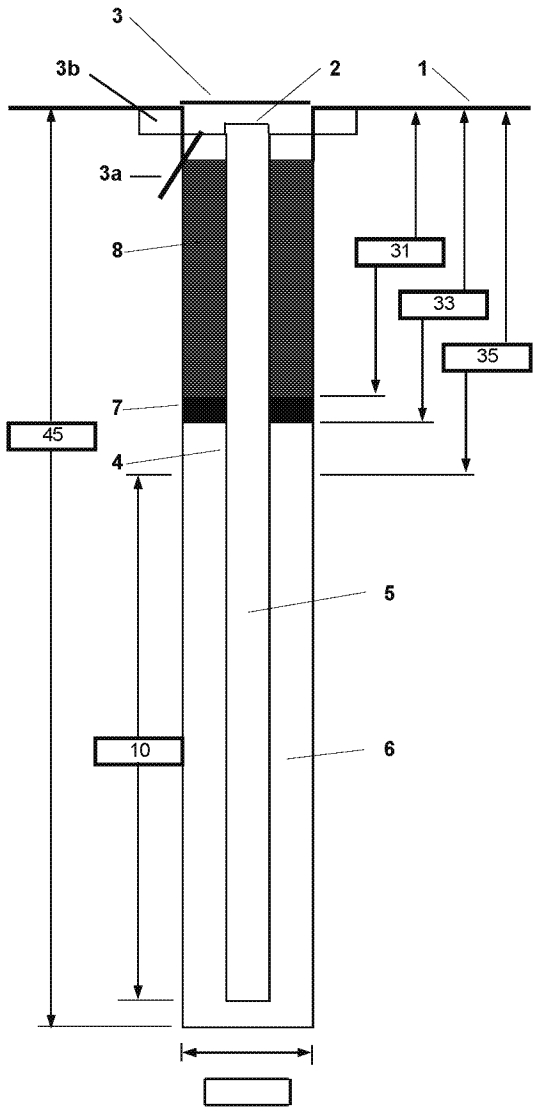
WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation LOCATION : Institute, WV

DRILLING CONTRACTOR : Cascade

DRILLING METHOD AND EQUIPMENT USED : Sonic Spider

WATER LEVELS : START : 7/21/2015 END :7/21/2015 LOGGER : W. Conway



1- Ground elevation at well: 586.19

2- Top of casing elevation: 585.87

3- Wellhead protection cover type: steel
a) drain tube?: yes
b) concrete pad dimensions: 2 x 2

4- Dia./type of well riser: 2 inch PVC

5- Type/slot size of screen: PVC 2 inch 0.010" slot size

6- Type screen filter: sand
a) Quantity used: 250 pounds

7- Type of seal: bentonite
a) Quantity used: 40 pounds

8- Grout
a) Grout mix used: cement bentonite grout
b) Method of placement: tremie
c) Vol. of well casing grout: 50 gallons

Development method: monsoon

Development time:

Estimated purge volume:

Comments:

PROJECT NUMBER	WELL NUMBER		
650363	TW-113	SHEET 1	OF 1

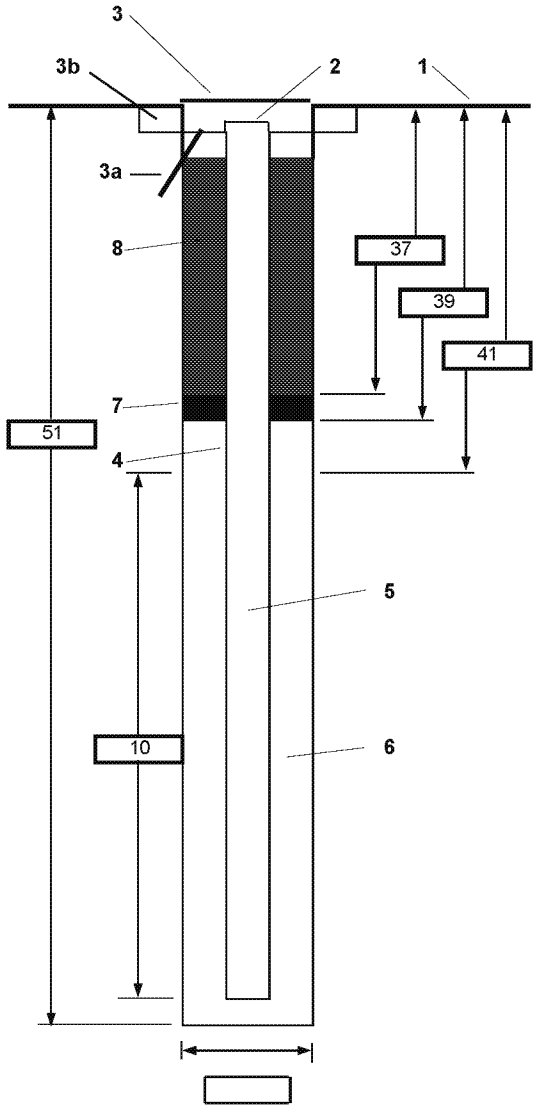
WELL COMPLETION DIAGRAM

PROJECT : Eastern Boundary Investigation LOCATION : Institute, WV

DRILLING CONTRACTOR : Cascade

DRILLING METHOD AND EQUIPMENT USED : Sonic Spider

WATER LEVELS : START : 7/22/2015 END :7/22/2015 LOGGER : W. Conway



1- Ground elevation at well: 592.91

2- Top of casing elevation: 592.59

3- Wellhead protection cover type: steel
- a) drain tube?: yes
- b) concrete pad dimensions: 2 x 2

4- Dia./type of well riser: 2 inch PVC

5- Type/slot size of screen: PVC 2 inch 0.010" slot size

6- Type screen filter: #5 sand
- a) Quantity used: 225 pounds

7- Type of seal: bentonite
- a) Quantity used: 30 pounds

8- Grout
- a) Grout mix used: cement bentonite grout
- b) Method of placement: freefall
- c) Vol. of well casing grout: 50 gallons

Development method: monsoon

Development time: 1.5 hours

Estimated purge volume: 70 gallons

Comments

January 2016

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0553 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/15/16 09:20 END : 1/15/16 11:30 LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		5.0		0.0-5.0' - no recovery - due to hand auger			
5	5.0						
		5.0/5.0	M-1	**Silty Clay (ML-CL)** 5.0-13.0' - light brown, damp, very stiff		0 0 0 0 0	
10	10.0						
		5.0/5.0	M-2			0 0 0 0 0	
				Silty Clayey Sand (SC-SM) 13.0-14.0' - light brown, damp to wet, loose		0	
				Silty Clay (ML-CL) 14.0-15.0' - light brown, damp, very stiff		0	
15	15.0						
				15.0-16.0' - no recovery			
				Silty Clay (ML-CL) 16.0-17.0' - light brown, damp, very stiff, gravel at 17'		0	
		4.0/5.0	M-3	**Silty Clayey Sand (SM)** 17.0-21.0' - light brown, damp to wet, 3" clay seam at 19.0'		0 0 0	
20	20.0						

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0553 SHEET 2 OF 3

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/15/16 09:20 END : 1/15/16 11:30 LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
						0	
		5.0 / 5.0	M-4	**Silty Clay (ML-CL)** 21.0-30.0' - light brown, damp to wet, medium stiff, occasional sand seams <1"		0 0 0 0	
25	25.0					0	
		5.0 / 5.0	M-5			0 0 0 0	
30	30.0						
		5.0 / 5.0	M-6	**very Sandy Silt (ML-CL)** 30.0-33.5' - gray, wet, soft		0 0 0	
				Clayey fine Sand (SC) 33.5-34.0' - gray, wet, soft		0	
35	35.0			**Silty Sandy Clay (ML-CL)** 34.0-35.0' - gray, wet, soft		0	
		5.0 / 5.0	M-7	**Silty fine Sand (SM)** 35.0-40.0' - gray, wet, loose		0 0 0	
40	40.0					0	
				40.0-47.0' - no recovery		0	Drillers start flooding with water due to heaving sand

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0553 SHEET 3 OF 3

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/15/16 09:20 END : 1/15/16 11:30 LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		0.0 / 5.0	M-8				
45	45.0					0	
		3.0 / 5.0	M-9	**Silty Sand (SM)** 47.0-50.0' - gray, wet, loose		0	
50	50.0			50.0-60.0' - no recovery		0	
		0.0 / 5.0	M-10				
55	55.0						
		0.0 / 5.0	M-11				
60	60.0						
				Bottom of Boring at 60.3 ft below ground surface			

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0554 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/18/16 10:35 END : 1/18/16 11:27 LOGGER : T. Mihal

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		2.5/5.0	M-1	**Silty Clay (CL)** 0.0-5.0' - light brown, dry, loose, trash from hand auger, low recovery		0 0 0 0 0	Breathing Zone 0
5	5.0						
		4.0/5.0	M-2	**Silty Clay (CL)** 5.0-6.0' - light brown, tight **Silty Clay (CL)** 6.0-9.0' - olive gray, moist, moderately tight, yellow orange Silt and clays at 7.5' - tight		0 0 0 0	Breathing Zone 0
10	10.0			9.0-10.0' - no recovery		0	
		4.5/5.0	M-3	**Silty Clay (CL)** 10.0-14.5' - light brown, dry, tight		0 0 0 0 0	Breathing Zone 0
15	15.0						
		4.0/5.0	M-4	**Silt and Sand (ML)** 15.0-19.0' - light brown, slight moisture, moderately tight		0 0 0 0	Breathing Zone 0
20	20.0			**Silty Clay (CL)** 19.0-25.0' - light brown, moist at 22.5', moderately tight, with fine sand		0	

PROJECT NUMBER:	BORING NUMBER:	
668827.01.FI	INS-0554	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V — LOCATION : Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- — START : 1/18/16 10:35 — END : 1/18/16 11:27 — LOGGER : T. Mihal

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0					0	
						0	
		5.0 / 5.0	M-5			0	Breathing Zone 0
						0	
25	25.0					0	
				Silty Clay (CL) 25.0-27.0' - light brown, dry, moderately tight, with fine sand		0	
						0	
		5.0 / 5.0	M-6	27.0-30.0' - olive gray, wet at 27.5', 3" sand lens at 28.5'		0	Breathing Zone 0
						0	
30	30.0					0	
				Sand (SC) 30.0-31.0' - gray, wet, moderately tight, fine grained		0	
				Silt and Clay (ML) 31.0-35.0' - olive gray, moist to saturated, some sand		0	
		4.0 / 5.0	M-7			0.1	Breathing Zone 0
						0.02	
35	35.0					0	
				Silt and Clay (ML) 35.0-36.5' - light gray, wet, fine grained sand		0	
				Sand (SC) 36.5-40.0' - saturated, fine grained, some clay		0.3	
		5.0 / 5.0	M-8			0.3	Breathing Zone 0
						0.2	
							Blind probe to refusal at 60.8 ft bgs
40	40.0					0.3	
				Bottom of Boring at 40.0 ft below ground surface			

PROJECT NUMBER:	BORING NUMBER:	
668827.01.FI	INS-0555	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V | LOCATION : Institute, WV

ELEVATION : | DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- | START : 1/21/16 08:30 | END : 1/21/16 09:00 | LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		0.0 / 5.0		0.0-5.0' - no recovery - due to hand clearing			Breathing Zone 0
5	5.0						
		5.0 / 5.0	M-1	**Silty Clay (ML-CL)** 5.0-10.0' - light brown, damp, very stiff, some orange staining		0 0 0 0 0	Breathing Zone 0
10	10.0						
		3.0 / 5.0	M-2	10.0-12.0' - no recovery **Silty Sand (SM)** 12.0-15.0' - light brown, damp, loose, fine grained sand		0 0 0	Breathing Zone 0
15	15.0						
		5.0 / 5.0	M-3	15.0-16.0' - no recovery **Sandy Silty Clay (CL)** 16.0-18.5' - light brown to gray, damp, soft, occasional sand stringers **Silty Sand (SM)** 18.5-20.0' - light brown, damp to wet at 19.5', fine grained		0 0 0 0 0	Breathing Zone 0
20	20.0						

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0555 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/21/16 08:30 END : 1/21/16 09:00 LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0			**Sandy Silty Clay (ML-CL)** 20.0-23.0' - light brown, damp to wet, soft, with occasional sand stringers		0	
		5.0 / 5.0	M-4			0	
						0	Breathing Zone 0
				Silty Sand (SM) 23.0-26.5' - light brown, wet, fine to coarse grained sand		0	
25	25.0					0	
						0	
		5.0 / 5.0	M-5	**Silty Sandy Clay (ML-CL)** 26.5-30.0' - light brown, wet, soft		0	
						0	Breathing Zone 0
						0	
30	30.0					0	
		5.0 / 5.0	M-6	**Silty Sandy Clay (ML-CL)** 30.0-36.5' - light brown to gray, wet, soft, with occasional sand stringers		0	
						0	
						0	Breathing Zone 0
						0	
35	35.0					0	
		5.0 / 5.0	M-7	**Silty fine Sand (SM)** 36.5-40.0' - light brown, wet, loose, fine grained sand		0	
						0	Breathing Zone 0
						0	
40	40.0					0	
				Bottom of Boring at 40.0 ft below ground surface			

PROJECT NUMBER:	BORING NUMBER:	
668827.01.FI	INS-0559	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V — LOCATION : Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- — START : 1/16/16 16:00 — END : 1/16/16 16:00 — LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		5.0		0.0-6.0' - no recovery due to hand auger			
5	5.0						
		4.0 / 5.0	M-1	**Silty Sandy Clay (ML-CL)** 6.0-10.0' - light brown to gray, damp, stiff		0 0 0 0 0	Breathing Zone 0
10	10.0						
		4.0 / 5.0	M-2	10.0-11.0' - no recovery **Sandy fine Gravel (GW)** 11.0-12.0' - black, damp, loose **Silty Clay (ML-CL)** 12.0-15.0' - light brown, damp, medium stiff		0 0 0 0	Breathing Zone 0
15	15.0						
		4.0 / 5.0	M-3	15.0-16.5' - no recovery **Sandy Silt (SM-ML)** 16.5-19.0' - dark brown, damp, soft, with clay		0 0 0	Breathing Zone 0
20	20.0			**Silty fine Sand (ML-SM)** 19.0-20.0' - dark brown, damp, loose		0	

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0559 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/16/16 16:00 END : 1/16/16 16:00 LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0			**Sand (SP)** 20.0-28.5' - light orange to tan, wet, loose, medium to fine grained		0	
						0	
		5.0 / 5.0	M-4			0	Breathing Zone 0
						0	
25	25.0					0	
						0	
						0	
		5.0 / 5.0	M-5			0	Breathing Zone 0
				Sandy Clayey Silt (ML) 28.5-30.0' - gray, damp to wet, soft		0	
30	30.0					0	
				Bottom of Boring at 30.0 ft below ground surface			
35							
40							

PROJECT NUMBER:	BORING NUMBER:	
668827.01.FI	INS-0563	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V — LOCATION : Institute, WV

ELEVATION : — DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- — START : 1/18/16 15:00 — END : 1/18/16 15:45 — LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
				0.0-5.0' - no recovery due to hand auger			
5	5.0						
		1.0 / 5.0	M-1	5.0-9.0' - no recovery			
				Fly Ash and Silt 9.0-10.0'		0	Breathing Zone = 0
10	10.0						
		5.0 / 5.0	M-2	**Silty Clay (ML-CL)** 10.0-15.0' - light brown, damp, stiff		0 0 0 0 0	
15	15.0						
				15.0-16.0' - no recovery		0	
		4.0 / 5.0	M-3	**Sandy Clayey Silt (CL-ML)** 16.0-18.5' - light brown, damp, soft		0 0	Breathing Zone = 0
				Clayey Silty Sand (SC-SM) 18.5-20.0' - light brown, damp, loose, fine grained		0 0	Breathing Zone = 0
20	20.0						

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0563 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/18/16 15:00 END : 1/18/16 15:45 LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0			20.0-21.0' - no recovery			▽ at 20-21' bgs
		4.0 / 5.0	M-4	**Sand (SP)** 21.0-25.0' - light brown to gray, wet, loose, fine to medium grained			
25	25.0			**Clayey Silt (CL-ML)** 25.0-25.5' - gray, wet, soft			
		5.0 / 5.0	M-5	**Silty Sand (SM)** 25.5-26.0' - gray, wet, loose **Silty Clay (ML-CL)** 26.0-29.5' - gray, damp to wet, with occasional sand partings			
30	30.0			**Sand (SW)** 29.5-30.0' - light brown, wet, loose, fine to medium grained Bottom of Boring at 30.0 ft below ground surface			
35							
40							

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0566 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/18/16 14:00 END : 1/18/16 14:50 LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		5.0		0.0-1.5' - no recovery **Fly Ash** 1.5-5.0' - gray			
5	5.0	0.0 5.0	M-1	5.0-24.0' - no recovery - trace fly ash on sleeve			very soft pushing, no hammer Breathing Zone = 0
10	10.0	0.0 5.0	M-2				Breathing Zone = 0
15	15.0	0.0 5.0	M-3			0	Breathing Zone = 0
20	20.0						

PROJECT NUMBER:	BORING NUMBER:	
668827.01.FI	INS-0566	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V | LOCATION : Institute, WV

ELEVATION : | DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- | START : 1/18/16 14:00 | END : 1/18/16 14:50 | LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0	1.0 / 5.0	M-4				▽ at 23' bgs
25	25.0			**Fly Ash** 24.0-25.0' - black, wet, soft, trace silt			
		5.0 / 5.0	M-5	25.0-26.5' - no recovery		0	
				Silty Clay (ML-CL) 26.5-30.0' - gray, damp to wet, soft, with occasional sand partings		0	
						0	
30	30.0					0	
				Bottom of Boring at 30.0 ft below ground surface			
35							
40							

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0570 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/18/16 10:30 END : 1/18/16 11:15 LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		5.0		0.0-6.0' - no recovery due to hand auger			
5	5.0						
		4.0/5.0	M-1	**Clayey Sandy Silt (ML)** 6.0-7.5' - light brown, damp, soft		0	Breathing Zone = 0
				Silty Sand (SM) 7.5-9.5' - light brown, damp, loose, fine grained		0	
						0	
10	10.0			**Sand (SP)** 9.5-10.0' - light brown, damp, loose, fine grained		0	
		2.5/5.0	M-2	10.0-12.5' - no recovery			Breathing Zone = 0
				Sandy Silt (ML) 12.5-14.0' - light brown, damp, soft, occasional sand partings		0	
						0	
15	15.0			**Sand (SP)** 14.0-15.0' - light brown, damp, loose, fine grained		0	
		4.0/5.0	M-3	15.0-16.0' - no recovery			Breathing Zone = 0
				Sand (SP) 16.0-25.0' - light brown, wet, loose, fine to medium grained		0	
						0	
20	20.0					0	

PROJECT NUMBER:	BORING NUMBER:	
668827.01.FI	INS-0570	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V | LOCATION : Institute, WV

ELEVATION : | DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- | START : 1/18/16 10:30 | END : 1/18/16 11:15 | LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0					0	
		5.0 / 5.0	M-4			0	Breathing Zone = 0
						0	
						0	
25	25.0					0	
				Sandy Clayey Silt (SM-ML) 25.0-26.5' - light brown, wet, soft		0	
		5.0 / 5.0	M-5	**Silty Clay (ML-CL)** 26.5-29.0' - orange, wet, loose, occasional sand partings		0	
						0	
						0	
30	30.0			**Sand (SP)** 29.0-30.0' - light brown, wet, loose, fine to medium grained		0	
				Bottom of Boring at 30.0 ft below ground surface			
35							
40							

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0573 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/21/16 11:00 END : 1/21/16 11:45 LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		5.0		0.0-5.0' - no recovery due to hand auger			
5	5.0						
		5.0/5.0	M-1	**Silty Clay (ML-CL)** 5.0-10.0' - light brown, damp, very stiff		0 0 0 0	Breathing Zone = 0
10	10.0					0.4	
		3.5/5.0	M-2	10.0-11.5' - no recovery		0	
				Sandy Clayey Silt (SM-ML) 11.5-13.5' - light brown, damp, soft		0 0	Breathing Zone = 0
				Silty Sand (SM) 13.5-14.0' - light brown, damp, loose, fine grained		0	▽ at 14' bgs
15	15.0			**Sand (SP)** 14.0-18.0' - light brown, wet, loose, fine grained		0.3	
		5.0/5.0	M-3			0.2 0 0	
				Silty Sandy Clay (ML-CL) 18.0-21.5' - light brown to gray, damp to wet, soft		0	
20	20.0					0.1	

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0573 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/21/16 11:00 END : 1/21/16 11:45 LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0					0	
		5.0 / 5.0	M-4	**Silty Sand (SM)** 21.5-25.5' - light brown, wet, loose, fine grained, occasional clay lenses <1"		0 0 0 0	
25	25.0					0	
		5.0 / 5.0	M-5	**Silty Clay (ML-CL)** 25.5-27.5' - light gray, damp, soft **Silty Clayey Sand (SC-SM)** 27.5-32.5' - light brown, wet, loose, fine grained		0 0 0 0 0 0	
30	30.0					0	
		2.5 / 5.0	M-6	32.5-35.0' - no recovery		0 0 0 0	Breathing Zone = 0
35	35.0					0	
		5.0 / 5.0	M-7	**Silty Sand (SM)** 35.0-40.0' - light brown to gray, wet, loose			
40	40.0						
				Bottom of Boring at 40.0 ft below ground surface			

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0574 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/21/16 09:45 END : 1/21/2016 LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
		5.0		0.0-5.0' - no recovery due to hand auger			
5	5.0						
		5.0/5.0	M-1	**Silty Clay (ML-CL)** 5.0-10.0' - tan to light brown, damp, very stiff		0 0 0 0 0	Breathing Zone = 0
10	10.0						
		4.0/5.0	M-2	10.0-11.5' - no recovery		0	Breathing Zone = 0
				Sandy Silty Clay (ML-CL) 11.5-14.0' - light brown, damp, medium dense, sand increases with depth		0 0 0	
				Silty Sand (SM) 14.0-15.0' - light brown, damp, loose, fine grained		0	
15	15.0						
		4.0/5.0	M-3	15.0-16.0' - no recovery		0	▽ at 15' bgs
				Silty Sand (SM) 16.0-20.0' - light brown, wet, loose, fine grained		0 0 0 0	
20	20.0					0	Breathing Zone = 0

PROJECT NUMBER:	BORING NUMBER:
668827.01.FI	INS-0574 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : WVO INS Eastern Property Investigation, Phase V LOCATION : Institute, WV

ELEVATION : DRILLING CONTRACTOR : Kodiak

DRILLING METHOD AND EQUIPMENT : DPT Geoprobe

WATER LEVELS : --- START : 1/21/16 09:45 END : 1/21/2016 LOGGER : P. Kish

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft)	RECOVERY (ft)	SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	COMMENTS
	20.0			20.0-21.0' - no recovery		0	
		4.0 / 5.0	M-4	**Silty Sand (SM)** 21.0-26.0' - light brown, wet, loose, fine grained		0 0 0 0	
25	25.0					0	Breathing Zone = 0
		5.0 / 5.0	M-5	**Silty Clay (ML-CL)** 26.0-27.5' - gray, wet, soft **Silty Sand (SM)** 27.5-28.0' - gray, wet, loose **Silty Sandy Clay (ML-CL)** 28.0-30.0' - gray, damp to wet, soft		0 0 0 0	
30	30.0					0	
		5.0 / 5.0	M-6	**Silty Clay (ML-CL)** 30.0-31.0' - light brown to gray, wet, soft **Silty Sand (SM)** 31.0-31.5' - light brown, wet, loose, fine grained **Silty Sandy Clay (ML-CL)** 31.5-35.0' - brown to gray, damp, soft			Breathing Zone = 0
35	35.0						Breathing Zone = 0
		0.0 / 5.0	M-7	35.0-40.0' - no recovery			
40	40.0						
				Bottom of Boring at 40.0 ft below ground surface			

Attachment 2
Analytical Laboratory Reports
(Presented on CD)

Attachment 3
DQE Validation Memorandums

December 2014

Data Quality Evaluation Eastern Property Boundary Groundwater Investigation, Dow UCC Institute Site, Institute, West Virginia

PREPARED FOR: Union Carbide Corporation (UCC)

PREPARED BY: CH2M

DATE: December 2014

Introduction

The objective of this data quality evaluation (DQE) report is to assess the data quality of analytical results for groundwater collected from the Eastern Property Boundary of The Dow Chemical Company (Dow) West Virginia Operations (WVO) Union Carbide Corporation (UCC) Institute site in Institute, West Virginia). CH2M collected samples October 21-26, 2014. Guidance for this DQE report came from the *Dow WVO Quality Assurance Project Plan (May 2012) (*Dow WVO QAPP*);* the *U.S. Environmental Protection Agency (USEPA) Contract Laboratory National Functional Guidelines (NFG) for Organic Review, October 1999;* and individual method requirements.

The analytical results were evaluated using the criteria of precision, accuracy, representativeness, comparability, and completeness (PARCC) as presented in the Dow WVO QAPP. This report is intended as a general data quality assessment designed to summarize data issues.

Analytical Data

This DQE report covers eight groundwater samples, 1 field duplicate (FD), 1 equipment blank (EB), and 3 trip blanks (TBs). The samples were reported in three sample delivery groups identified as L14101378, L14101569, and L14101743. Samples were collected and delivered to Microbac Laboratories, Inc. (MBLM) in Marietta, Ohio. The samples were analyzed by the methods listed in Table 1.

Table 1. Analytical Parameters
Institute Eastern Property Boundary Groundwater Investigation, Dow West Virginia

Parameter	Method	Laboratory
Volatile Organic Compounds (VOC)	SW8260B	MBLM
Semivolatile Organic Compounds (SVOC)	SW8270C/SW8270 SIM	MBLM

The sample delivery groups were assessed by reviewing the following: 1) the chain of custody documentation; 2) holding-time compliance; 3) initial and continuing calibration criteria; 4) method blanks/field blanks; 5) laboratory control spiking sample/laboratory control spiking sample duplicate (LCS/LCSD) recoveries and precision; 6) matrix spike/matrix spike duplicate (MS/MSD) recoveries and precision; 7) surrogate spike recoveries; 8) FD precision;(9) internal standard (IS) recoveries; and 10) the required quality control (QC) samples at the specified frequencies.

Data flags were assigned according to the Dow WVO QAPP. Multiple flags are routinely applied to specific sample method/matrix/analyte combinations, but there will only be one final flag. A final flag is applied to the data and is the most conservative of the applied validation flags. The final flag also includes matrix and blank sample impacts.

The data flags are those listed in the Dow WVO QAPP and are defined below:

- J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
- R = The sample result was rejected due to serious deficiencies in the ability to analyze the sample and meet the QC criteria. The presence or absence of the analyte could not be verified.
- U = The analyte was analyzed for but was not detected above the reported sample quantitation limit.
- UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- B = The analyte was detected in the associated blank as well as the samples.
- K = The analyte was positively identified, but the associated numerical value may be biased high.
- L = The analyte was positively identified, but the associated numerical value may be biased low.
- UL = The analyte was analyzed for but was not detected. The quantitation limit may be biased low.

Findings

The overall summaries of the data validation are contained in the following sections. Qualified data are listed in Table 2.

Holding Time/Preservation

Samples 0467-GW01-102114 and 0467-GW02-102114 were extracted one day past the hold time criteria of 7 days for semivolatile organic compounds (SVOCs). The data were qualified as estimated detected and non-detected results and flagged "J" and "UJ," respectively, in the samples.

Calibration

Initial and continuing calibration analyses were performed as required by the methods and all acceptance criteria were met with the following exceptions:

The percent difference (%D) for dichlorodifluoromethane was less than method criteria in the volatile organic compound (VOC) initial calibration verification standards (ICVS), indicating a possible low sample bias. The data were qualified as estimated non-detects and flagged "UJ" in the samples.

The %D for acetone was less than method criteria in a few VOC continuing calibration verification standards (CCV), indicating a possible low sample bias. The data were qualified as estimated non-detects and flagged "UJ" in the associated samples. In addition, the %Ds for dichlorodifluoromethane and/or trichlorofluoromethane were greater than criteria in a few VOC CCVs, indicating a possible high bias. The data were not qualified because the associated samples did not contain reportable levels of these analytes.

Method Blanks

Method blanks were analyzed at the required frequency and were free of contamination.

Laboratory Control Samples

LCS/LCSDs were analyzed as required and all accuracy and precision criteria were met with the following exception:

The relative percent difference (RPD) for dichlorodifluoromethane exceeded criteria in one VOC LCS/LCSD. The data were not qualified because the samples did not contain reportable levels of dichlorodifluoromethane.

Matrix Spike

MS/MSD samples were analyzed as required and all accuracy and precision criteria were met with the following exceptions:

Isophorone was recovered greater than the upper control limit in the SVOC MS/MSD for sample 0467-GW01-102114, indicating a possible high bias. The result was not qualified because the parent sample did not contain a reportable level of isophorone.

Internal Standards

ISs were added to all samples and all acceptance criteria were met.

Surrogates

Surrogates were added to all samples for methods requiring their use and all acceptance criteria were met with the following exceptions:

One surrogate was recovered less than criteria in the SVOC analysis of sample 0468-GW02-102414, indicating a possible low bias. The data were qualified as estimated non-detects and flagged "UL" in the sample.

One surrogate was recovered greater than criteria in the SVOC analysis of samples 0468-GW01-102414 and 0467-GW02-102114, indicating a possible high bias. Detected results were qualified as estimated and flagged "K" in the samples. Non-detected results were not qualified.

Field Duplicates

An FD was collected as required and all precision criteria were met.

Field Blanks

TBs and an EB were collected, analyzed and were free of contamination with the following exception:

Acetone was detected at a concentration greater than the reporting limit (RL) in the VOC EB and one TB. The data were not qualified because the samples did not contain reportable levels of acetone.

Chain of Custody

Required procedures were followed and were generally free of errors.

Overall Assessment

The goal of this assessment is to demonstrate that a sufficient number of representative samples were collected and the resulting analytical data can be used to support the decision-making process. The following summary highlights the PARCC findings for the above-defined events:

Precision of the data was verified through the review of the field and laboratory data quality indicators that include FD, LCS/LCSD, and MS/MSD RPDs. Although a few precision indicators exceeded criteria, the data were not impacted. Precision was acceptable.

Accuracy of the data was verified through the review of the calibration data, LCS/LCSD, MS/MSD, internal standards, and surrogate standard recoveries, as well as the evaluation of method/field blank data. Accuracy was generally acceptable with the exception of a few analytes being qualified as estimated detected and non-detected results due to calibration and/or surrogate issues. Acetone was detected in the EB and one TB; however, the data were not impacted. Data users should consider the impact to any result that is qualified as it may contain a bias that could affect the decision-making process.

Representativeness of the data was verified through the sample's collection, storage, and preservation procedures, and the verification of holding time compliance. No issues were noted due to sample collection, storage, or preservation procedures. Samples 0467-GW01-102114 and 0467-GW02-102114 were extracted 1 day past hold time criteria for SVOCs, resulting in the data being qualified as estimated detected and non-detected results. All other data were reported from analyses within the USEPA recommended holding time.

Comparability of the data was verified through the use of standard USEPA analytical procedures and standard units for reporting. Results obtained are comparable to industry standards in that the collection and analytical techniques followed approved, documented procedures.

Completeness is a measure of the number of valid measurements obtained in relation to the total number of measurements planned. Completeness is expressed as the percentage of valid or usable measurements compared to planned measurements. Valid data are defined as all data that are not rejected for project use. All data were considered valid. The completeness goal of 90 percent was met for all method/analytes combinations. The data can be used for project decisions taking into consideration the validation flags applied to the data.

Table 2. Qualified Data

Institute Eastern Property Boundary Groundwater Investigation, Dow West Virginia

NativeID	Method	Analyte	Units	Final Result	Validation Flag	Validation Reason
0465-GW01-102714	SW8260B	Acetone	µg/L	5	UJ	CCV<LCL
0465-GW01-102714	SW8260B	Dichlorodifluoromethane	µg/L	1	UJ	ICVS<LCL
0465-GW02-102714	SW8260B	Acetone	µg/L	5	UJ	CCV<LCL
0465-GW02-102714	SW8260B	Dichlorodifluoromethane	µg/L	1	UJ	ICVS<LCL
0466-GW01-102814	SW8260B	Acetone	µg/L	5	UJ	CCV<LCL
0466-GW01-102814	SW8260B	Dichlorodifluoromethane	µg/L	1	UJ	ICVS<LCL
0466-GW02-102814	SW8260B	Acetone	µg/L	5	UJ	CCV<LCL
0466-GW02-102814	SW8260B	Dichlorodifluoromethane	µg/L	1	UJ	ICVS<LCL
0466-GW02-102814D	SW8260B	Acetone	µg/L	5	UJ	CCV<LCL
0466-GW02-102814D	SW8260B	Dichlorodifluoromethane	µg/L	1	UJ	ICVS<LCL
0467-GW01-102114	SW8260B	Dichlorodifluoromethane	µg/L	1	UJ	ICVS<LCL
0467-GW01-102114	SW8270C	1,4-Dioxane	µg/L	10.8	UJ	HTp>UCL

Table 2. Qualified Data

Institute Eastern Property Boundary Groundwater Investigation, Dow West Virginia

NativeID	Method	Analyte	Units	Final Result	Validation Flag	Validation Reason
0467-GW01-102114	SW8270C	Isophorone	µg/L	5.38	UJ	HTp>UCL
0467-GW01-102114	SW8270C	Naphthalene	µg/L	5.38	UJ	HTp>UCL
0467-GW02-102114	SW8260B	Dichlorodifluoromethane	µg/L	1	UJ	ICVS<LCL
0467-GW02-102114	SW8270C	1,4-Dioxane	µg/L	22.2	K	Sur>UCL, HTp>UCL (J)
0467-GW02-102114	SW8270C	Isophorone	µg/L	5.38	UJ	HTp>UCL
0467-GW02-102114	SW8270C	Naphthalene	µg/L	5.38	UJ	HTp>UCL
0468-GW01-102414	SW8260B	Acetone	µg/L	2.5	UJ	CCV<LCL
0468-GW01-102414	SW8260B	Dichlorodifluoromethane	µg/L	0.25	UJ	ICVS<LCL
0468-GW02-102414	SW8260B	Acetone	µg/L	2.5	UJ	CCV<LCL
0468-GW02-102414	SW8260B	Dichlorodifluoromethane	µg/L	0.25	UJ	ICVS<LCL
0468-GW02-102414	SW8270C	1,4-Dioxane	µg/L	6.33	UL	Sur<LCL
0468-GW02-102414	SW8270C	Isophorone	µg/L	3.16	UL	Sur<LCL
0468-GW02-102414	SW8270C	Naphthalene	µg/L	3.16	UL	Sur<LCL

Validation Reasons:

CCV<LCL = The initial calibration verification was recovered less than criteria.

HTp>UCL = The preparatory hold time exceeded criteria.

ICVS<LCL = The initial calibration verification was recovered less than criteria.

Sur<LCL = The surrogate was recovered less than the lower control limit.

Sur>UCL = The surrogate was recovered greater than the upper control limit.

March 2015

Data Quality Evaluation 1,4-Dioxane Study, Dow UCC Institute Site, Institute, West Virginia

PREPARED FOR: Union Carbide Corporation (UCC)

PREPARED BY: CH2M HILL (CH2M)

DATE: March 25, 2015

Introduction

The objective of this data quality evaluation (DQE) report is to assess the data quality of analytical results for groundwater samples collected from The Dow Chemical Company (Dow) West Virginia Operations (WVO) Union Carbide Corporation (UCC) Institute site in Institute, West Virginia, and to compare analytical results between two laboratories. CH2M collected samples February 10-12, 2015. Guidance for this DQE report came from the *Dow WVO Quality Assurance Project Plan (May 2012) (Dow WVO QAPP);* the *U.S. Environmental Protection Agency (USEPA) Contract Laboratory National Functional Guidelines for Organic Data Review, October 1999;* and, individual method requirements.

The analytical results were evaluated using the criteria of precision, accuracy, representativeness, comparability, and completeness (PARCC) as presented in the Dow WVO QAPP. This report is intended as a general data quality assessment designed to summarize data issues.

Analytical Data

This DQE report covers 10 groundwater samples, 2 field duplicates (FDs), and 1 equipment blank (EB). The samples were reported in two sample delivery groups identified as EPR01 and L15020725. Samples were collected and delivered to Microbac Laboratories, Inc. (MBLM) in Marietta, Ohio, and Eurofins (formerly Lancaster) in Lancaster, Pennsylvania. The samples were analyzed by the method listed in Table 1.

Table 1. Analytical Parameters

1,4-Dioxane Study, Institute, West Virginia

Parameter	Method
1,4-Dioxane	SW8270 SIM

The sample delivery groups were assessed by reviewing the following: 1) the chain of custody documentation; 2) holding-time compliance; 3) initial and continuing calibration criteria; 4) method blanks/field blanks; 5) laboratory control spiking sample/laboratory control spiking sample duplicate (LCS/LCSD) recoveries and precision; 6) surrogate spike recoveries; 7) internal standard (IS) recoveries; and, 8) the required quality control (QC) samples at the specified frequencies.

Data flags were assigned according to the Dow WVO QAPP. Multiple flags are routinely applied to specific sample method/matrix/analyte combinations, but there will only be one final flag. A final flag is applied to the data and is the most conservative of the applied validation flags. The final flag also includes matrix and blank sample impacts.

The data flags are those listed in the Dow WVO QAPP and are defined below:

- J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
- R = The sample result was rejected due to serious deficiencies in the ability to analyze the sample and meet the QC criteria. The presence or absence of the analyte could not be verified.
- U = The analyte was analyzed for but was not detected above the reported sample quantitation limit.
- UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- B = The analyte was detected in the blank as well as the samples.
- K = The analyte was positively identified, but the associated numerical value may be biased high.
- L = The analyte was positively identified, but the associated numerical value may be biased low.
- UL = The analyte was analyzed for but was not detected. The quantitation limit may be biased low.

Findings

The overall summaries of the data validation are contained in the following sections.

Holding Time/Preservation

All acceptance criteria were met.

Calibration

Initial and continuing calibration analyses were performed as required by the method and all acceptance criteria were met.

Method Blanks

Method blanks were analyzed at the required frequency and were free of contamination.

Laboratory Control Samples

LCS/LCSDs were analyzed as required and all accuracy and precision criteria were met.

Internal Standards

Internal standards were added to all samples and all acceptance criteria were met.

Surrogates

Surrogates were added to all samples and all acceptance criteria were met.

Field Blanks

One EB was collected and analyzed, and was free of contamination.

Chain of Custody

Required procedures were followed and were generally free of errors.

Data Comparison

The percent difference (%D) between the 1,4-dioxane results from each laboratory were within the allowable criteria of 50 percent for split samples except for samples 0470-GW01-021015 and 0470-GW01-021015S, which had a %D of 77 percent.

Overall Assessment

The goal of this assessment is to demonstrate that a sufficient number of representative samples were collected and the resulting analytical data can be used to support the decision-making process. The following summary highlights the PARCC findings for the above-defined events:

Precision of the data was verified through the review of the field and laboratory data quality indicators that include FD and LCS/LCSD RPDs. Precision was acceptable.

Accuracy of the data was verified through the review of the calibration data, LCS/LCSD, internal standards, and surrogate standard recoveries, as well as the evaluation of method/field blank data. Accuracy was acceptable.

Representativeness of the data was verified through the sample's collection, storage, and preservation procedures, and the verification of holding time compliance. The laboratory did not note any issues related to sample preservation or storage of the samples. All data were reported from analyses within the USEPA recommended holding time.

Comparability of the data was verified through the use of standard USEPA analytical procedures and standard units for reporting. Results obtained are comparable to industry standards in that the collection and analytical techniques followed approved, documented procedures.

Completeness is a measure of the number of valid measurements obtained in relation to the total number of measurements planned. Completeness is expressed as the percentage of valid or usable measurements compared to planned measurements. Valid data are defined as all data that are not rejected for project use. All data were considered valid. The completeness goal of 90 percent was met for all method/analytes combinations. The data can be used for project decisions taking into consideration the validation flags applied to the data.

References

CH2M. 2012. *Dow WVO Quality Assurance Project Plan*. Prepared for Union Carbide Corporation. May.

U.S. Environmental Protection Agency (USEPA). 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*. OSWER 9240.1-05A-P. EPA540/R-99/008.

September 2015

Data Quality Evaluation Eastern Property Boundary Investigation, Dow UCC Institute Site, Institute, West Virginia

PREPARED FOR:	Union Carbide Corporation (UCC)
PREPARED BY:	CH2M
DATE:	September 2015

Introduction

The objective of this data quality evaluation (DQE) report is to assess the data quality of analytical results for groundwater and air samples collected from The Dow Chemical Company (Dow) West Virginia Operations (WVO) Union Carbide Corporation (UCC) Institute site in Institute, West Virginia. CH2M collected samples from June 25 through August 1, 2015. Guidance for this DQE report came from the *Dow WVO Quality Assurance Project Plan (May 2012) (Dow WVO QAPP);* the *U.S. Environmental Protection Agency (USEPA) Contract Laboratory National Functional Guidelines for Organic Data Review, October 1999;* and, individual method requirements.

The analytical results were evaluated using the criteria of precision, accuracy, representativeness, comparability and completeness (PARCC) as presented in the Dow WVO QAPP. This report is intended as a general data quality assessment designed to summarize data issues.

Analytical Data

This DQE report covers 22 groundwater samples, 2 field duplicate (FD), 4 equipment blanks (EBs), and 4 trip blanks (TBs). The samples were reported in six sample delivery groups identified as EPR02, EPR03, EPR04, EPR05, EPR06 and EPR07. The samples were collected and delivered to Eurofins Lancaster Laboratories (LANC) in Lancaster, Pennsylvania. The samples were analyzed by one or more of the methods listed in Table 1.

Table 1. Analytical Parameters
Institute Eastern Property Boundary Investigation, Dow West Virginia

Parameter	Method	Laboratory
Volatile Organic Compounds (VOC)	SW8260B	LANC
Semivolatile Organic Compounds (SVOC)	SW8270C/SIM	LANC

The sample delivery groups were assessed by reviewing the following: 1) the chain of custody documentation; 2) holding-time compliance; 3) initial and continuing calibration criteria; 4) method blanks/field blanks; 5) laboratory control spiking sample/laboratory control spiking sample duplicate (LCS/LCSD) recoveries and precision; 6) surrogate spike recoveries; 7) internal standard (IS) recoveries; and, 8) the required quality control (QC) samples at the specified frequencies.

Data flags were assigned according to the Dow WVO QAPP. Multiple flags are routinely applied to specific sample method/matrix/analyte combinations, but there will only be one final flag. A final flag is applied to the data and is the most conservative of the applied validation flags. The final flag also includes matrix and blank sample impacts.

The data flags are those listed in the Dow WVO QAPP and are defined below:

- J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
- R = The sample result was rejected due to serious deficiencies in the ability to analyze the sample and meet the QC criteria. The presence or absence of the analyte could not be verified.
- U = The analyte was analyzed for but was not detected above the reported sample quantitation limit.
- UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- B = The analyte was detected in the blank as well as the samples.
- K = The analyte was positively identified, but the associated numerical value may be biased high.
- L = The analyte was positively identified, but the associated numerical value may be biased low.
- UL = The analyte was analyzed for but was not detected. The quantitation limit may be biased low.

Findings

The overall summaries of the data validation are contained in the following sections. Qualified data are listed in Table 2.

Holding Time/Preservation

All acceptance criteria were met.

Calibration

Initial and continuing calibration analyses were performed as required by the method and all acceptance criteria were met with the following exceptions:

The percent difference (%D) for bis(2-chloroisopropyl)ether was less than criteria in one continuing calibration verification (CCV) standard associated with Method SW8270C, indicating a possible low bias. The analyte was qualified as an estimated non-detected result and flagged "UJ" in the associated sample. In addition, the %D for bis(2-chloroisopropyl)ether was greater than criteria in one CCV, indicating a possible high bias. The data were not qualified because the associated samples did not contain reportable levels of bis(2-chloroisopropyl)ether.

Method Blanks

Method blanks were analyzed at the required frequency and were free of contamination.

Laboratory Control Samples

LCS/LCSDs were analyzed as required and accuracy and precision criteria were met with the following exceptions:

Bis(2-ethylhexyl)phthalate was recovered less than the lower control limit in one LCS associated with Method SW8270C, indicating a possible low bias. The data were qualified as estimated detected and non-detected results and flagged "L" and "UL," respectively, in the associated samples.

The recovery for 1,2-dichloroethane was greater than the upper control limit in one LCS associated with Method SW8260B, indicating a possible high bias. The data were not qualified because the associated samples did not contain reportable levels of 1,2-dichloroethane.

Internal Standards

Internal standards were added to the samples and acceptance criteria were met.

Surrogates

Surrogates were added to the samples and acceptance criteria were met with the following exceptions:

One surrogate associated with the base fraction of Method SW8270C was recovered less than the lower control limit in sample TW108-GW01-07082015, indicating a possible low bias. The data were qualified as estimated non-detected results and flagged "UL" in the sample.

One or more surrogates associated with the acid fraction of Method SW8270C were recovered less than 10 percent in samples TW104-GW01-06252015 and MW104-GW01-07112015, indicating a possible significant low bias. The data were rejected for project use and flagged "R" in the samples.

One surrogate associated with the base fraction of Method SW8270C SIM was recovered less than the lower control limit in samples TW102-GW01-07092015 and TW107-GW01-07072015, indicating a possible low bias. The data were qualified as estimated detected and non-detected results and flagged "L" and "UL," respectively, in the samples.

Matrix Spike Samples

MS/MSDs were analyzed as required and accuracy and precision criteria were met with the following exceptions:

A few analytes were recovered less than the lower control limits in the MS associated with Method SW8260B for sample TW110-GW01-07312015, indicating a possible low bias. The data were qualified as estimated detected and non-detected results and flagged "L" and "UL," respectively, in the parent sample.

Field Blanks

EBs and TBs were collected and analyzed, and were free of contamination with the following exception:

Bis(2-ethylhexyl)phthalate was detected at a concentration greater than the reporting limit in one EB associated with Method SW8270C. The data were not qualified because the associated samples did not contain reportable levels of bis(2-ethylhexyl)phthalate.

Field Duplicates

FDs were collected, analyzed and all precision criteria were met.

Chain of Custody

Required procedures were followed and were generally free of errors.

Overall Assessment

The goal of this assessment is to demonstrate that a sufficient number of representative samples were collected and the resulting analytical data can be used to support the decision-making process. The following summary highlights the PARCC findings for the above-defined events:

Precision of the data was verified through the review of the laboratory data quality indicators that include LCS/LCSD RPDs. Precision was acceptable.

Accuracy of the data was verified through the review of the calibration data, LCS/LCSD, internal standards, and surrogate standard recoveries, as well as the evaluation of method/field blank. Accuracy was generally acceptable with the exception of a few analytes being qualified as estimated detected and non-detected results due to calibration LCS/LCSD, MS/MSD, and/or surrogate issues. In addition, phenol was rejected for project use in two semivolatile organic compound (SVOC) samples due to surrogate issues. Bis(2-ethylhexyl)phthalate was detected at a concentration greater than the reporting limit in one EB; however, the associated data were not impacted. Data users should consider the impact to any result that is qualified as it may contain a bias which could affect the decision-making process.

Representativeness of the data was verified through the sample's collection, storage, and preservation procedures and the verification of holding time compliance. The laboratory did not note any issues related to sample preservation or storage of the samples. All data were reported from analyses within the USEPA recommended holding time.

Comparability of the data was verified through the use of standard USEPA analytical procedures and standard units for reporting. Results obtained are comparable to industry standards in that the collection and analytical techniques followed approved, documented procedures.

Completeness is a measure of the number of valid measurements obtained in relation to the total number of measurements planned. Completeness is expressed as the percentage of valid or usable measurements compared to planned measurements. Valid data are defined as all data that are not rejected for project use. All data were considered valid with the exception of phenol, which was rejected for project use in two samples. The completeness goal of 90 percent was met for all method/analytes combinations with the exception of phenol which was 78 percent complete. The data can be used for project decisions taking into consideration the validation flags applied to the data.

Table 2. Qualified Data

Institute Eastern Property Boundary Investigation, Dow West Virginia

NativeID	Method	Analyte	Units	Final Result	Validation Flag	Validation Reason
MW104-GW01-07112015	SW8270C	Bis(2-chloroisopropyl)ether	µg/L	1	UJ	CCV<LCL
MW104-GW01-07112015	SW8270C	Phenol	µg/L	1	R	Sur<LCL
TW102-GW01-07092015	SW8270CSIM	1,4-Dioxane	µg/L	0.59	L	Sur<LCL
TW102-GW01-07092015	SW8270CSIM	Bis(2-chloroethyl)ether	µg/L	0.053	UL	Sur<LCL
TW104-GW01-06252015	SW8270C	Bis(2-ethylhexyl)phthalate	µg/L	22	L	LCS<LCL
TW104-GW01-06252015	SW8270C	Phenol	µg/L	1	R	Sur<LCL

Table 2. Qualified Data

Institute Eastern Property Boundary Investigation, Dow West Virginia

NativeID	Method	Analyte	Units	Final Result	Validation Flag	Validation Reason
TW104-GW02-06252015	SW8270C	Bis(2-ethylhexyl)phthalate	µg/L	5	UL	LCS<LCL
TW107-GW01-07072015	SW8270CSIM	1,4-Dioxane	µg/L	2.2	L	Sur<LCL
TW108-GW01-07082015	SW8270C	Isophorone	µg/L	1	UL	Sur<LCL
TW108-GW01-07082015	SW8270C	Naphthalene	µg/L	0.5	UL	Sur<LCL
TW110-GW01-07312015	SW8260B	1,1-Dichloroethene	µg/L	5	L	MS<LCL
TW110-GW01-07312015	SW8260B	1,2-Dichloroethane	µg/L	0.5	UL	MS<LCL
TW110-GW01-07312015	SW8260B	Benzene	µg/L	0.5	UL	MS<LCL
TW110-GW01-07312015	SW8260B	Chloroform	µg/L	1.1	L	MS<LCL

Validation Reasons:

CCV<LCL = The continuing calibration verification was recovered less than criteria.

LCS<LCL = The laboratory control sample was recovered less than the lower control limit.

MS<LCL = The matrix spike sample was recovered less than the lower control limit.

Sur<LCL = The surrogate was recovered less than the lower control limit.

References

CH2M. 2012. *Dow WVO Quality Assurance Project Plan*. Prepared for Union Carbide Corporation. May.

U.S. Environmental Protection Agency (USEPA). 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*. OSWER 9240.1-05A-P. EPA540/R-99/008.

March 2016
(Presented on CD)

Attachment 4
Historical Aerial Photographs and Topographic Maps


INQUIRY #: 4395961.4
YEAR: 1955
= 750'
N
EDR

Historical Topographic Map

N			
	TARGET QUAD NAME: SAINT ALBANS MAP YEAR: 1958 SERIES: 7.5 SCALE: 1:24000	SITE NAME: UCC Institute Fac.Eastern Boundary Investigation ADDRESS: HWY I-64 and State Route 25 Dunbar, WV 25064 LAT/LONG: 38.3795 / -81.7665	CLIENT: CH2M Hill, Inc. CONTACT: Brett Fishwild INQUIRY#: 4395961.1 RESEARCH DATE: 08/28/2015


INQUIRY #: 4395961.4
YEAR: 1971
= 500'
N
EDR